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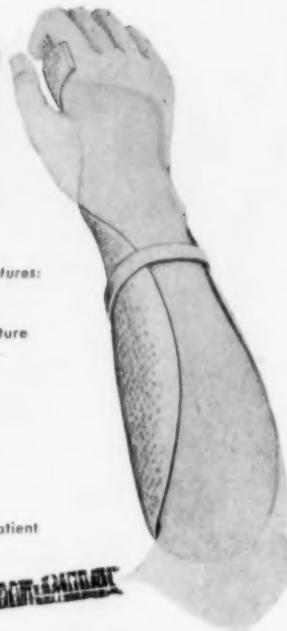
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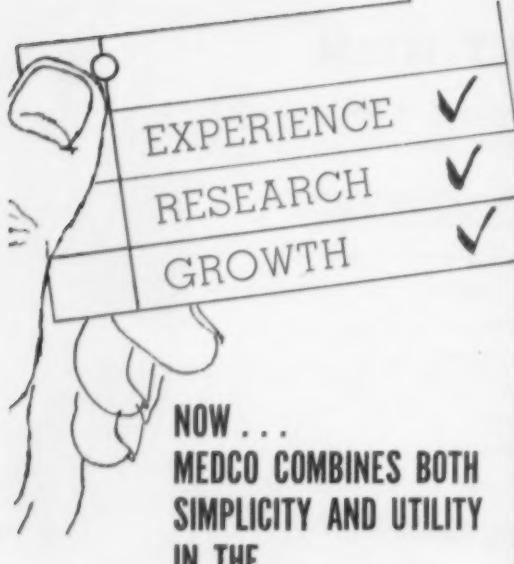
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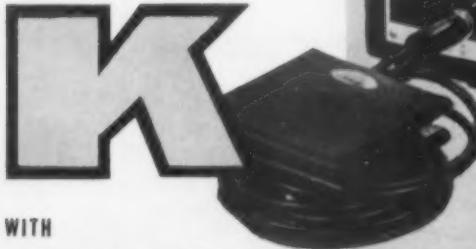
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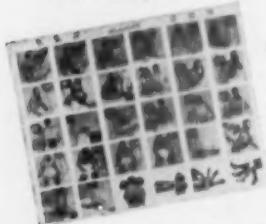
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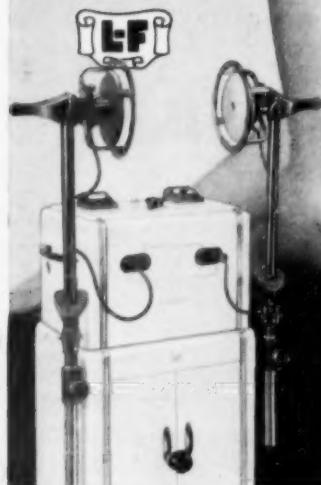
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The Rejection of Help By Some Disabled People

Ian Alger, M.D.
and
Howard A. Rusk, M.D.
New York City

The field of rehabilitation is one which is characterized by optimism. The physician offers the patient new hope that life can again hold its former richness and rewards. The results hoped for are not in terms of organs or limbs alone, but rather in terms of the adjustment of the total individual so that he may again assume a satisfying and productive place in society.

However, these high hopes and aspirations of the physician often are not fulfilled. The bedsores of the patient with the spinal cord injury does not heal rapidly. The patient with rheumatoid arthritis very frequently returns, and his pains persist.

Actually, the result of rehabilitation is not dependent solely upon the efforts of the rehabilitation workers. The result is a function of factors related to the patient as well, and it is really the interplay of the two sets of factors, those connected with the patient, and those connected with the therapy, which determines the outcome. Let us first analyze the position of the patient in this relationship a little more thoroughly.

The Patient

Many significant categories might be identified. One would be the actual physical disability. Another significant category of important factors related to the patient would be his motivation, or lack of motivation. The problem of motivation is an extremely complex one, which holds particular interest for the psychiatrist on the rehabilitation team. As described by Menninger,¹ he can make a definite contribution toward this problem's solution by reason of his special insight into the character structure and behavior patterns of the patient. This factor of motivation can also be broken down into subfactors, and in the examples provided in the present paper one of these factors will be discussed. This particular aspect of motivation is the pa-

tient's attitude toward his receiving help. Apparently, many people in our society find it a humiliating experience to receive help. The presence of such an attitude tends to sabotage the work of rehabilitation. It should be made clear that such an attitude about obtaining help is by no means restricted to those who are disabled. Indeed, as noted, it would seem to be a widespread attitude in our culture, and undoubtedly was a well-established aspect of the personality structures of these patients prior to the development of their physical disabilities.

The fact that the character structure of a patient, including specific attitudes such as the one in question here concerning help, existed prior to the onset of the disability cannot be overemphasized. Recognition of this concept is important because it enables us to view the patient's neurotic reaction to his disability in proper perspective. The neurotic reaction is not something new brought about by the disability. Rather, the neurotic reaction to the disability is only another example of the specific patient's typical way of reacting to stress situations in life. In the present instance, concerning a particular feeling toward receiving help, it will be demonstrated that the attitude toward rejection of help in the rehabilitation setting was also an attitude that was shown at home, in school, and at work before there was any disability. Bonime² has clearly shown the practical implications of this concept as they relate to psychotherapeutic technics, where an attempt is made to change the neurotic

Read at the Thirty-second Annual Session of the American Congress of Physical Medicine and Rehabilitation, Washington, D.C., September 8, 1954.
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Professor and Chairman, Department of Physical Medicine and Rehabilitation, New York University-Bellevue Medical Center.

From the Departments of Psychiatry, and Physical Medicine and Rehabilitation, New York University-Bellevue Medical Center.

This study was made possible through grants provided by the Commonwealth Fund.

way of reacting. Two cases were followed over fairly long periods of time in individual psychotherapy. A few examples from these cases will illustrate some of the effects this attitude toward receiving help can have on the rehabilitation process.

Examples

The first patient was a man 35 years of age whose paraplegia was of traumatic origin. At the time he was seen in intensive psychotherapy, he had been disabled for many years, and was being evaluated again because of a recurring genitourinary problem. His injury had occurred while he was quite young and his academic career was interrupted. After his initial treatment, he had tried to adjust in several work situations but had not been able to make a permanent decision about his occupation. He consulted with many physicians all over the world concerning his disability, and tended to postpone acting on the advice of any one physician until he was able to consult with another one. He was an extremely independent person who took special pride in caring for himself completely; he maneuvered his wheelchair with reckless abandon, and would propel it fiercely down the street and over the curb into the midst of heavy traffic, waving and calling for a taxicab, completely indifferent to the other somewhat more powerful vehicles on the street. When he was leaving the office after one therapy session, an offer was made to help him down a set of three stairs in the hall. Brushing aside this help, he rolled his wheelchair over them at fast speed, as he grimaced in pain at each bump the wheelchair took. In the psychotherapy sessions, he remained in his wheelchair until one day, after several weeks of treatment, he moved to a lounge chair in the office and was able to admit that he had remained in the wheelchair because that way he was able to be in a more elevated position than the psychiatrist, and hence felt superior. He resented bitterly the limitation which his disability placed on him. In spite of his insistence on this arrogant approach to living, and his dis-

dain for the help of others, he agreed to undertake psychotherapy because of the dawning realization of his own dissatisfaction with his isolated and lonely life. A few months after therapy was begun, he started to realize the nature of his neurotically competitive approach to life which accounted for his scorning the help of others. At this time, he said: "Before I started this treatment, if anyone had told me that I had the attitude that everyone is out to get everyone else, I wouldn't have believed it." During his six months in psychotherapy, the patient became more aware of his competitive struggle with other people and was able to make closer and closer relationships. As this happened, he also found that he was more able to accept the assistance of others when it was needed, without his previous feelings of injured pride and anger.

The second patient was a single woman of 33 years, with a residual disability from poliomyelitis of a paralysis of one arm and some weakness of the homolateral leg. She began psychotherapy after her depression was noted in physical therapy classes. A major part of the psychiatric difficulty concerned her interpretation of her disability as a punishment. In addition, her suspiciousness of people's motives, and her resentment at having to accept help from these same people, were formidable barriers to recovery. She was extremely critical of everyone's effort to help her and always seemed to be manufacturing reasons to disparage the doctors, nurses, and therapists. Her attitude was one of always looking for the faults of others. For this reason, every offer of assistance was met with an attack from the patient. During the second month of therapy, she admitted: "I get so angry at myself for having to ask for help." She went on to describe several episodes at the hospital, on public vehicles, and in restaurants, where she needed assistance but had been absolutely unable to make any demand for help, since she felt such requests would be interpreted as weakness and would make her the object of others' contempt. During one and one-

half years of intensive psychotherapy, she gained increasing insight into these reactions and a more realistic acceptance of her residual disability. With this insight and acceptance, she found it was more and more possible for her to request, and to accept, help from others.

From these two illustrations, certain common factors can be isolated. Both patients tried for the most part to live unto themselves; both leading emotionally isolated lives. Each possessed an extremely competitive attitude, which reflected itself in every contact with other people. They were always alert lest they should be attacked by others, and were always more than ready to be critical and intolerant of other people's behavior. Obtaining help was interpreted as a sign of weakness, and similarly to patients described by Moore and Bonime,² both felt that those who offered help actually had contempt for others who were disabled.

Conclusions

It would seem that people with this attitude toward receiving help have a highly developed competitive approach to life and gain satisfaction from supremacy; by being better, or stronger, or more clever than others. Objective achievement takes a secondary place to achievement over others, and mastery over others carries with it feelings of contempt for the vanquished. Such neurotic people are actually pleased when they find inadequacies in other people, since this gives them relative ascendancy. Thus, the supremacy that these highly competitive people need to feel over others may be achieved either by actual superiority on their own part, or by derogation of those in competition. It can now be seen why asking for help is such a difficult thing for those with such an abnormally competitive outlook. In seeking help, they acknowledge that someone else can assist them in achieving what they alone could not achieve, and this is experienced as an admission of inferiority. These individuals believe that help will be given to them with the same feelings of condescension and contempt

that they themselves have for those "weaklings" who have needed *their* assistance. It must, of course, be understood that these attitudes are usually not ones of which such people are aware. The effects of these attitudes, however, are undoubtedly more widespread and damaging because of the very fact that they do operate for the most part outside of awareness.

The meaning of the disability itself to these competitive people should be considered. As noted by Bychowski,³ and as elaborated in detail by Adler,⁴ the handicap is felt as an inferiority, and is the source of feelings of shame and humiliation. Of course, in one sense the disabled person is inferior. His ability to engage in certain activities, and to perform certain functions is impaired depending on the extent of his disability. But this limitation of certain functions does *not* make him inferior as a human being. It is this latter feeling of lowered self-esteem, and its companion feeling of now being the object of others' contempt, which are the result of neurotic distortion, and which were demonstrated in the cases outlined.

The neurotically competitive person, who has become disabled, may thus enter the rehabilitation setting already feeling shame and inferiority because of his impairment in functioning. One might expect that he would welcome the help of the rehabilitation team, since it would aid him in overcoming his disability, or as he sees it, his inferiority. But instead, it is at this point that such a person may face what he considers the final disgrace. In order to gain improvement, he must undergo the additional humiliation of admitting his further helplessness by working with the rehabilitation team. At this stage, some of these patients become openly hostile and belligerent, and try to sabotage the whole program. Others react in a less obvious manner, but the same malignant attitudes are present and undermine the rehabilitation effort.

We have examined one aspect of the patient's motivation, or lack of motivation, in considerable detail. We see that

a psychological problem of the patient may prevent the attainment of the desired result in rehabilitation. Thus, when the progress in a case is discouragingly slow, the physician may find the explanation in one of the factors related to the patient, and he should not feel that he, the physician, should bear the entire burden of the responsibility.

This is not to say that the therapy and the therapists are not vital factors in determining the kind of results achieved in rehabilitation. As noted earlier, it is the interaction of factors connected with therapy, and factors connected with the patient, which leads to the rehabilitation result. It might be well, then, to examine briefly some of the factors in therapy, in a way similar to that in which we have already examined several factors in the patient.

One significant category of therapeutic factors would be the adequacy and suitability of available medical facilities. Another would include the attitudes and psychiatric skill of the physician. It is this latter category which would be called upon by the physician in an attempt to cope with problems in attitude found in the patients.

Again using as an example the particular attitude towards receiving help already described, let us see how various physicians and therapists might respond to patients with this attitude. Obviously the response of these rehabilitation workers will play a significant part in the progress and final result of treatment in each patient.

In the first place, a doctor or therapist *might* have a personal conviction that a physical disability *does* make one inferior as a human being. Kessler⁶ has discussed this eventuality. The belief might not be one held in full consciousness, but rather might be one kept in somewhat dim awareness. In such a case, the therapist would really be suffering from the same psychological problem as the patient, and, as emphasized by Barker and Wright,⁷ would be of little help to the patient, since he would only serve to confirm the neurotic ideas about people that the patient held all along.

Again, the doctor or therapist might find himself becoming quite annoyed and actually angry at patients like the ones given as illustrations in this paper. Such a reaction on the physician's part would not be difficult to understand, since we have seen that these neurotically competitive patients are especially critical of those who try to help them. They attempt to find fault with the hospital, the doctors, the therapists, the nurses, and seemingly everything and everybody. They often encourage other patients to voice complaints, and may stir up a demoralizing amount of discontent on a ward. They engage in this destructive type of activity in an attempt to gain status for themselves, by tearing down other people. But the fact remains that such patients can be very trying, and a frequent reaction to their behavior is one of anger. Such anger may result in the doctor's avoiding this patient, or it may result in the actual speedy discharge of the patient from the treatment center. Certainly, getting rid of the patient either by avoiding him, or by discharging him may make the physician feel better, but it really will not *help* the patient. And interestingly enough, the patient will have won his neurotic point, since he didn't want to accept *help* anyway. But the goal of the physician is certainly not to fulfill the neurotic needs of the patient. What is then needed in such a situation is a psychiatric approach to the problem. This approach will be catalytic by allowing the other therapeutic factors, such as excellent hospital equipment, and capable physical therapists to operate with greater prospect of success.

By the term psychiatric approach, it is not meant that a psychiatrist must be involved in each case. It is true that in some cases the special training and skills of the psychiatrist will be needed. But the psychiatric approach is one which can be used by any physician who appreciates the important psychological factors which are always operating in both the patient, and in himself. The insecure and psychiatrically naive physician may strike back at the patient who

criticizes his diagnosis, or treatment recommendations. He will then not help the patient. The physician with psychiatric orientation will recognize the criticism for what it is, namely, the expression of another one of the patient's problems; in this instance, a psychological problem. This latter physician will then be able to cope with the problem in a rational and therapeutic manner, often by himself, or, in more involved cases, in consultation with his psychiatric colleague.

Summary

An attempt has been made to examine the complex relationship between the patient and the physician, with special emphasis on one aspect of the problem of motivation, or lack of motivation in the patient; namely, the problem encountered when certain patients reject help, and try to sabotage the rehabilitation program. In such a situation it is felt that only when the psychological factors present in both the disabled patient and his therapist are understood, and adequately dealt with, can there be attainment of a *realistic* rehabilitation

result.

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IMPORTANT NOTICE: CHANGE OF EXAMINATION DATE

AMERICAN BOARD OF PHYSICAL MEDICINE AND REHABILITATION

The next examinations for the American Board of Physical Medicine and Rehabilitation will be held in Philadelphia, June 10, 11 and 12, 1955.

Changes in Permeability of the Red Blood Cell Membrane in a Homogeneous Ultrasonic Field

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Effects of Ultrasound

There are two biologically important effects of ultrasound at the low therapeutic intensity, the so-called selective heating effect and the mechanical effect.

The first is the result of localized heating at the interfaces of media of the different acoustic impedance. The majority of authors agree that the quantitatively predominant part of ultrasound energy is transformed into such spot-like localized heat at the interfaces and is responsible for a major part of the biophysical action.

The second factor at low intensities of ultrasound is the powerful high frequency mechanical oscillation, with its mechanical effects, such as displacement, acceleration of molecules, powerful stirring effect, and rapid pressure changes inside the ultrasonic field. There may be other factors in the biophysical action which are not yet known. Even with the present knowledge, there is still controversy concerning the relative significance of the heating and mechanical action of ultrasound on the living organism.

The mechanical action can be explored by measuring the changes in permeability of a properly chosen biological membrane. The human erythrocyte affords such a suitable membrane.¹ Normally, this membrane is practically impermeable to K ions with a gradient of some 90 mEq/L from inside out. Under experimental conditions in properly buffered solutions, the slow rate of normal diffusion of potassium has been accurately measured.^{2*} Furthermore, the minute thickness of the membrane (below 200 Å) makes localized heating by ultrasound unlikely. The accelerated loss of potassium from the red cell has been measured extensively in studies on hemolytic agents. The presence of free hemoglobin outside the red cell serves

as a ready check on gross disruption of the membrane.

Experimental Procedures

The blood was supplied by six volunteers with normal blood findings. Thirty-five to 40 ml. of blood were drawn from the antecubital vein; a solution of crystalline heparin was added in the amount of 50 cat units/10 ml. of blood.

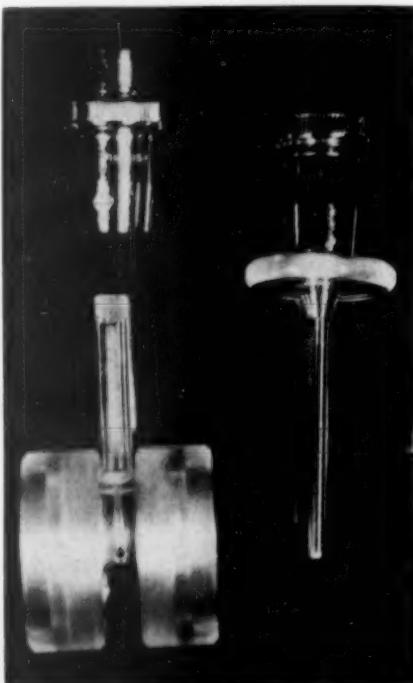


Fig. 1 — Plastic chamber and thermistor in place.

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From the Department of Physical Medicine and Rehabilitation, Columbia University College of Physicians and Surgeons, and the Presbyterian Hospital in the City of New York.

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The packed volume of the red blood cells was determined by Winthrop hematocrit, and the blood after chilling was centrifuged to separate the cells. Part of the plasma was removed, and a buffered Locke's solution containing glucose was added in such amount that the final erythrocyte concentration was 33 per cent. This buffered Locke's solution is known to reduce K diffusion to a very slow rate.⁴

For exposure of the erythrocytes to ultrasound energy, a specially designed plastic chamber of 10 ml. capacity was utilized to obtain a practically homogeneous ultrasound field (fig. 1). It was designed to eliminate as much as possible, multiple reflections, refraction or standing wave interference. Two of these plastic chambers were filled with the erythrocyte suspension. One of these was placed in the ultrasound field in a glass water tank of rectangular shape, filled with degassed distilled water. The ultrasound generating transducer (furnished through the courtesy of Dallons Laboratories, Inc., Los Angeles) was immersed at one end of the tank so that the ultrasound energy was projected horizontally in one direction only, in the long axis of the tank (fig. 2). The test chamber was placed at a distance of 50 mm. from the transducer membrane in such a way that the longitudinal ultrasound waves entered the polystyrene

membrane of $\lambda/2$ thickness at right angles, and after passing the content of the chamber and the other membrane, were absorbed by a sound-absorbing wall at the opposite side of the tank. The ultrasound energy output could be regulated from 0.25-3.34 W/cm², with an effective area of 12.5 cm². The water bath temperature was thermostatically controlled; a motor-driven propeller was used for stirring the water. The temperature of the water in the tank and of the specimen inside the chamber was continuously measured with the accuracy of $\pm 0.05^\circ\text{C}$. The time of exposure to the ultrasound field varied in different experiments between 5' and 30', being for most of the samples 10'. In all cases, the temperature inside the chamber was not allowed to rise over 37.2°C . The control chamber was immersed in another tank with the temperature of the water kept at $37^\circ\text{C} \pm 0.1^\circ\text{C}$.

After exposure, both samples were briefly chilled and centrifuged to separate the plasma. One ml. of the supernatant solution of each was pipetted for determination of each of the following: Hemoglobin content, K and Na cations. Similar measurements were made of the original plasma and of the initial mixture of plasma and Locke's solution.

The K and Na ion concentrations of the solutions were measured with the Baird flame photometer operated with

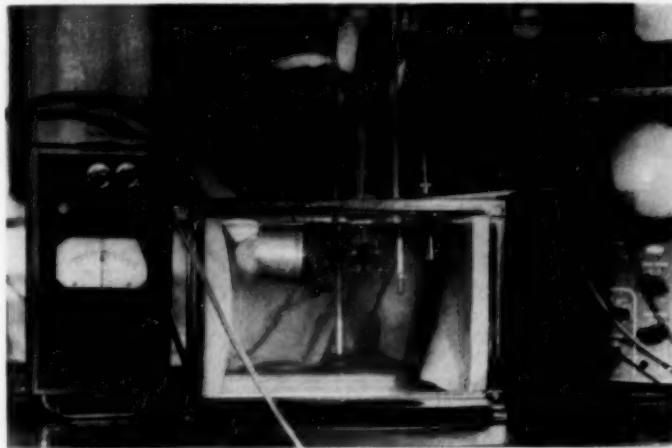


Fig. 2 — General arrangement of the apparatus.

Hematocrit: 54%, erythrocyte suspension 33% in 67% of plasma and Locke as Plasma: (K) 4.45 mEq/l, (Na) 135.0 mEq/l, Hb...0.012 gm/100 ml Temperature of the suspension 37 C. ± 0.2 C., distance 50 mm. Exposure time: 10 min., U.S. field 1 MC, intensity 2.5 w/cm²

U.S. exposed	Not exposed control
Hb from laking 0.07gm/100ml	0.02gm/100ml
(K ₁) 6.1 mEq/l	4.6 mEq/l
(K ₂) 120.5 mEq/l	126.6 mEq/l
(K ₁) plas. + L. 4.45 mEq/l	(K ₁) 4.45mEq/l
(K ₂) laking 0.02 "	(K ₂) 0.01 "
(K ₃) n. diff. 0.1 "	(K ₁) + (K ₂) 4.5 "
(K ₂) + (K ₃) 4.6 "	(K ₁) 4.6 "
(K ₄) 6.1 "	
(K ₄) due to U.S. 1.5 mEq/l	(K _F) - (K ₁ +K ₂) 0.1 mEq/l = (K ₃)

Fig. 3 — Protocol of typical experiment.

a lithium internal standard.⁶ The hemoglobin was determined by the Evelyn and Malloy⁶ method, using a Beckman Type B Spectrophotometer.

K in the exposed sample was calculated as follows:

$$\begin{aligned} & (K_1 \text{ from plasma and Locke's} \\ & \text{solution} \quad + \\ & (K_2 \text{ from laking}^* \quad + \\ K_{\text{final}} = & (K_3 \text{ from normal diffusion} \quad + \\ & (K_4 \text{ from ultrasound} \quad + \end{aligned}$$

Thus, potassium due to action of ultrasound: $K = K_{\text{final}} - (K_1 + K_2 + K_3)$

Results

As figure 3 shows, under the action of ultrasound, there is passage of excess K ions from the erythrocytes into the plasma. The increase in the K ion concentration as compared with the control sample is directly related to the intensity of the ultrasound field and to the time of exposure (fig. 4). The amount of K ions passing the erythrocyte membrane causes increments in K of the supernatant fluid which range from 0.10 mEq/L up to 1.91 mEq/L, while ultrasound energy is applied in the therapeutic range from 0.5-3.00 W/cm². This demonstrable increase in K shows a logarithm-shaped curve relation between the mEq/L of K and the intensity of

ultrasound in W/cm² (fig. 5). The plasma hemoglobin, due to laking, shows some rise with the increasing ultrasound level but far less than the K ions.

The increase in potassium ion concentration of the suspending solution, although small in absolute figures, represents a many-fold increase over normal diffusion under these conditions. This increase is well beyond the experimental error in every instance and follows a definite pattern in relation to ultrasound exposure. It is well to note that with the hematocrit set at 33 per cent, a change in concentration in the supernatant represents a two-fold change in concentration within the red cell.

The Na ion determination, which was done only as a control procedure, showed a slight decrease in the suspending solution for the ultrasound-exposed blood as shown in the following example: Plasma 141.6; untreated control 140.8; treated ultrasound — 137.0 mEq/L. These small changes show a similar pattern in most of the other experiments, and presumably represent a back diffusion of Na into the red cells.

Discussion

The setup and the technic of the experiments were arranged with the intention of producing as much of a homogeneous ultrasound field as was practically possible. Many of the previous studies of biophysical action of ultrasound disregarded this consideration,

*The K from laking was calculated on the assumption that for every 30 gm. Hgb from laking, approximately 10 mEq K go into the plasma.

with resulting multiple reflection at the interfaces, scattering, and shear (transverse) waves. The thickness of the membrane through which the ultrasound enters or leaves the container with the specimen also is of utmost importance. According to Bergmann,⁷ the maximum reflection takes place R_{\max} when $d = (2n-1) \lambda/4$ maximum transmittance D_{\max} when $d = n\lambda/2$, d = thickness, $n = 1, 2, 3, \dots$. For this reason, the plastic chamber containing the specimen was designed with both membrane windows of exact thickness of $\lambda/2$. The material used is polystyrene which has, according to Bergmann, a low degree of reflection

of ultrasound at the interface H₂O—polystyrene only 12 per cent as compared with oil—glass, 67 per cent. Further, to eliminate multiple reflection and scattering of ultrasound in the tank, a technic similar to that recommended by Giacomini⁸ was used for absorption of ultrasound, namely two sound-absorbing panels at the opposite walls of the tank. The even distribution of ultrasound was controlled by measurement with thermistors (diameter 2 mm.) and by direct visualization of the ultrasound pathway, using the optical striation method as described by Bergmann and others,^{7,8} (fig. 6 and 7).

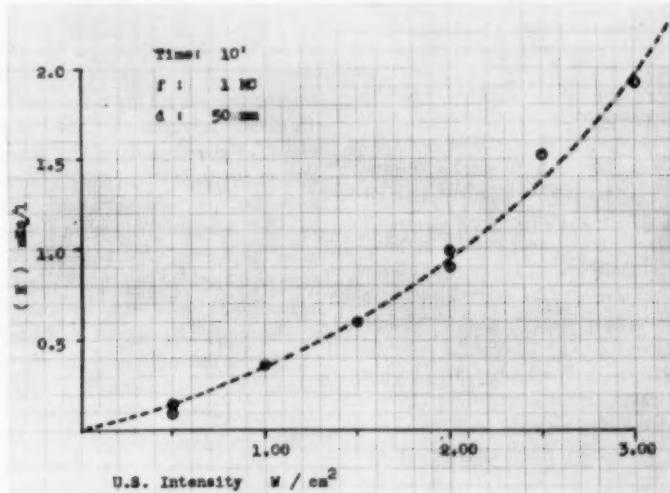


Fig. 4 — Relationship of potassium diffusion to intensity of ultrasound.

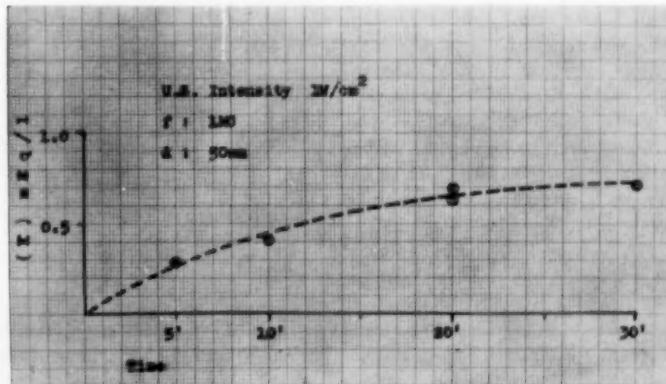


Fig. 5—Relationship of potassium diffusion to length of exposure to ultrasound.

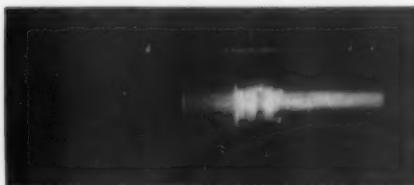


Fig. 6 — Photographic demonstration of uniformity of ultrasound field by striation method.

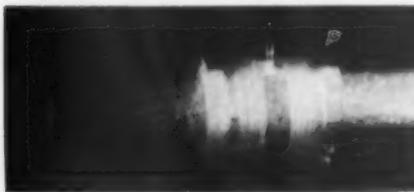


Fig. 7 — Similar to figure 6 but showing in addition elimination of reflection of ultrasound.

Analyzing the curve showing the relation of the intensity of ultrasound field and the amount of K cations which diffuse through the erythrocyte membrane, it seems that very low intensities below 1 W/cm² produce relatively little K diffusion. In intensities over 1 W/cm², there is rapid increase in K ion diffusion. If the temperature had been allowed to rise further, we would probably have obtained even greater changes. However, in the present experiments we desired to avoid massive thermal effects.

From previous experiments, it seems that the increased permeability of the human erythrocyte for K ions at the normal temperature of 37 C. and in the therapeutical range of ultrasonic field (0.5-3W/cm²) is probably due to the mechanical stirring effect or combined mechanical and thermal effect of ultrasound. The membrane of a human erythrocyte, according to Wangh and Schmitt,¹ is composed of lamellae of interposed lipids and proteins, the total thickness being in the range of 150-200 Å. There is probably little possibility of production of localized heat at the interfaces by reflection or shear waves on such a tiny interface composed probably of only a few layers of molecules. It seems unlikely that the ultrasound waves with a λ of about 1.5 mm. could produce a significant reflection on an interface of 150 Å, a relation of about

10,000:1.

Some authors, as Piersol, et al.⁹ agree that specific heating effects on the erythrocyte membrane are not to be expected because of insignificance of structural absorption of blood or erythrocyte suspension. According to their conclusions, the protein molecules are responsible for the entire ultrasound absorption in the blood and the structural elements of the blood (RBC, WBC and thrombocytes) do not change the degree of absorption. Only the total protein content is important and thus only the volume absorption in erythrocytes suspension in diluted plasma is of practical significance.

In larger membranes, it has been shown¹⁰⁻¹² that the specific heat developed at interfaces is probably responsible for the major part of the biophysical effect of ultrasound. The mechanical effect of ultrasound, in the form of displacement and acceleration of molecules with pressure changes and stirring effects,¹³⁻¹⁵ even if quantitatively smaller than the specific thermal effect, may be a significant factor in changes of permeability in cells of different tissue.

Although the exact mechanisms by which the potassium gradient is maintained in the human red cell are unknown, it is generally assumed that an active metabolic process keeps the concentration high in the erythrocyte, and counteracts leakage. It is possible but unlikely, that ultrasound energy affects this metabolic mechanism. A single experiment indicated that after exposure to ultrasound energy, further incubation at 37 C. led to back diffusion of at least some of the excess potassium lost by the red cell during ultrasound exposure. This small piece of evidence makes it unlikely that ultrasound causes permanent change in either the metabolic mechanism or in the membrane itself.

Summary

Human erythrocytes were exposed to ultrasound energy in a practically homogeneous field. The relatively even distribution of the ultrasound energy and the elimination of undesirable multiple

reflection, scattering, and shear (transverse) waves were accomplished by special design and arrangement of the components. The time of exposure was between 5 and 30 minutes; the ultrasound intensity level between 0.5-3 W/cm², and the frequency of ultrasound 1000 KC. The temperature of the erythrocyte suspension during ultrasound exposure and of the control was kept at 37°C. ± 0.2°C. The K and Na cation concentrations of the plasma in the exposed and control samples showed an increase of potassium from 0.10—1.91 mEq/L due to ultrasound action. The hemoglobin concentration of the plasma in the ultrasound-treated sample showed only very slight increase, which proved that there is no gross damage of the erythrocyte membrane due to ultrasound. The increased permeability of the erythrocyte membrane for K ions due to ultrasound energy suggests that the mechanical action of ultrasound, namely the stirring effect, is probably responsible for this action. The thermal effect is probably less important in exposure of blood to ultrasound energy as long as the ultrasound intensity is low and the temperature of the blood does not exceed the normal biological range. More work will be required to determine the changes in permeability of erythrocytes and other living tissue cells under different conditions.

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Temperature Changes Produced by Spraying with Ethyl Chloride

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Ethyl chloride spray has been employed as a local and as a general inhalation anesthetic. It has also been used as a local obtundent for the care of myalgias and arthralgias and for other conditions.¹⁻⁶ Explanations for its action have included depression of tactile sensitivity and refrigeration of tissue. On the basis of investigations previously performed with the applications of cold, it occurred to one of us (W.B.) that a substantial lowering of deep tissue temperature might also follow surface spraying with ethyl chloride.⁷

Technic

This procedure was applied to ten human subjects; to the region of the calf in five, and to that of the knee in the other five. To our knowledge, the cardio-vascular status of all of these subjects was normal except for one (S.C.), who had a venous ligation performed two years previously. Ethyl chloride was sprayed on the skin over an area about five inches in diameter. The spraying was performed intermittently so as to avoid frosting, applying from fifty to one hundred grams of the solution during a period of about fifteen to thirty minutes.

Determinations were made with iron-constantan-thermocouples inserted into size nineteen hypodermic needles. These were connected to a six-channel Leeds and Northrup Micromax® which automatically indicated and recorded temperatures at one minute intervals. Intramuscular determinations were made in the triceps surae at a depth of about one and one-quarter inches and in the vastus medialis at about three-quarters of an inch beneath the surface. Other thermocouples were inserted subcutaneously, into the knee joint, and placed on the skin. The intra-articular needles

were inserted behind the patella at its medial margin.

Results

Temperature findings at the beginning of each investigation and at the lowest recorded levels as observed on the skin and in the subcutaneous and intramuscular areas are indicated in table 1. Table 2 shows the temperature values in the knee joint and vastus medialis. It will be noted that the greatest fall in temperature occurred on the skin surface and in the subcutaneous tissues. In the calf muscle, temperatures fell from 2 to 7.5 F. Knee joints cooled from 3.5 to 5.7 F. Intramuscular temperatures continued to decline after cessation of the ethyl chloride spray and had not returned to the original levels during the time of our observation which covered about one to two hours. Characteristic changes, as automatically recorded at six minute intervals, are shown in graphs 1 and 2.

Discussion

In all instances, spraying of the skin surface with ethyl chloride caused a fall of temperature at a depth in living humans. It required several minutes before the fall in muscle temperature became evident. Travell's period of observation was too brief to record intramuscular temperature depressions.⁸ Knee joint temperatures fell at a faster rate than did those within the calf muscle. The changes in joint temperatures observed following the application of cold are in accord with the findings of Wakim, et al⁹ and contrary to those reported by Hollander and Horvath.¹⁰ The

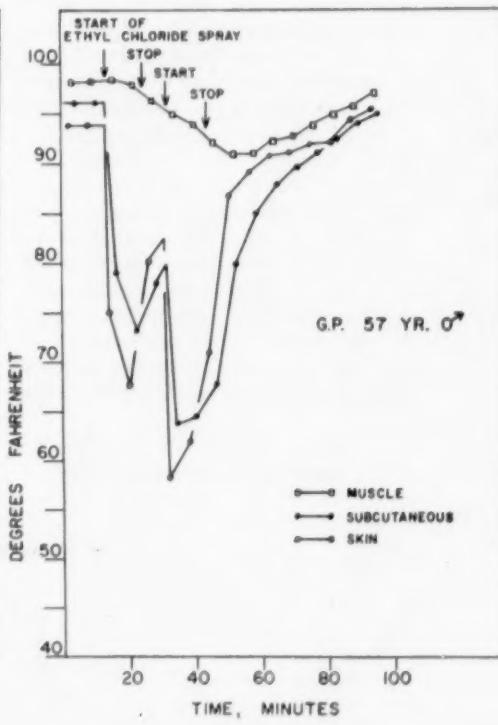
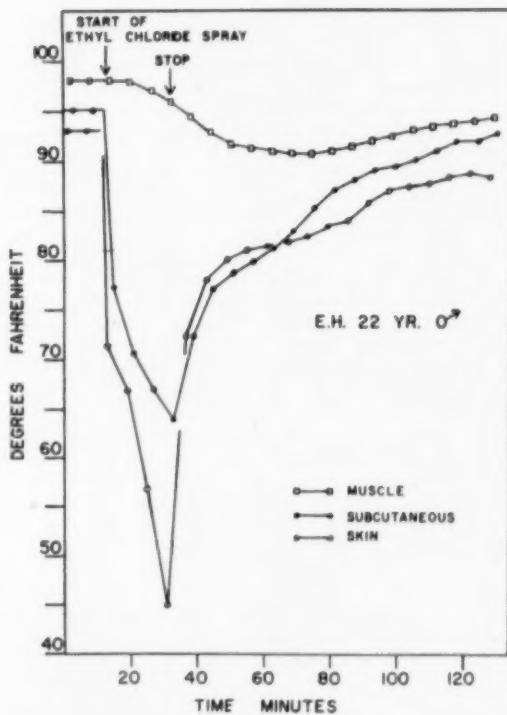
Read at the Thirty-second Annual Session of the American Congress of Physical Medicine and Rehabilitation, Washington, D.C., September 9, 1954.
From the Department of Physical Medicine, Mount Sinai Hospital.

Table 1: Initial and lowest skin, subcutaneous and intramuscular temperatures of the calf. Calf (F°)

Subject	Age	Sex	SKIN			SUBCUTANEOUS			INTRAMUSCULAR		
			Start	Low	Fall	Start	Low	Fall	Start	Low	Fall
E. H.	22	M	92.9	45.0	47.9	95.1	64.0	31.1	98.1	90.9	7.2
G. P.	57	M	93.8	58.4	35.4	96.0	63.0	32.1	98.5	91.0	7.5
L. R.	50	F	91.5	36.6	54.9	92.0	70.8	21.2	95.1	90.8	4.3
S. C.	53	M	92.3	66.1	26.2	93.2	66.0	27.2	97.5	92.4	5.1
H. R.	58	M	90.7	52.0	48.7	91.8	75.0	16.8	95.0	93.0	2.0

Table 2. Initial and lowest intra-articular and intra-muscular temperatures of the knee joint and vastus medialis. Knee and Vastus Medialis (F°)

Subject	Age	Sex	KNEE (INTRA-ARTICULAR)			INTRAMUSCULAR		
			Start	Low	Fall	Start	Low	Fall
R. C.	18	M	98.5	94.8	3.7	99.0	93.6	5.4
E. S.	23	F	99.6	95.0	4.6	99.6	96.8	2.8
A. P.	28	F	98.5	95.0	3.5	99.2	98.0	1.2
B. F.	30	M	97.5	91.8	5.7	98.5	94.2	4.3
R. B.	42	M	98.9	93.3	4.7	97.2	93.2	4.0



small series of our observations does not permit of statistical evaluation as to average, median, or mode. The uncontrolled variables include total area treated, time and technic of applications, initial temperature and mass of affected tissues.

It is possible that the fall in tissue temperatures may be due both to the direct abstraction of heat and to reflex action. Both explanations are tenable on the basis of results recorded following the application of other methods of cooling such as ice bags and drafts of cold air;¹² and the diminution of muscle hypertonus in an extremity on immersion of its distal portion in ice water.¹³ That vasoconstriction is a factor is indicated by the delayed dispersion of radioactive sodium following ethyl chloride spraying.¹⁴

The local and deep chilling of tissues resulting from ethyl chloride spray may be accompanied by other changes, such as in circulation, metabolism, and nerve conductivity. The manner in which cooled tissue returns to its original temperature level may be of diagnostic and of therapeutic significance. Such observations may offer a new technic for the study of peripheral circulation in skin and in muscle.

With the lowering of skin temperature, as a result of ethyl chloride spraying in the manner described, there occurs a diminution of sensitivity to pin prick and to light touch, but no anesthesia. These mild neurological changes do not appear to be adequate to explain the therapeutic changes observed following the use of ethyl chloride spray.

Conclusion

The spraying of the skin surface of

living humans with ethyl chloride causes a marked lowering of temperatures, to the greatest extent on the skin, and to a somewhat lesser degree in subcutaneous areas and least, but still substantial, in muscles at a depth.

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Poliomyelitis, The Sequelae: Five Year Follow-Up Study

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It is generally well recognized and accepted that the problem of disability and its increasing magnitude constitutes a serious situation for both the health and economic status of the United States. Data from the "Preliminary Report by the Panel on Rehabilitation of the President's Commission on Health Needs of the Nation, May 1952"¹ indicate that disabilities resulting from chronic diseases, congenital defects, and injuries, in varying degrees handicap nearly 30 million persons in this country, and that approximately 250,000 persons of working age become vocationally disabled every year. Poliomyelitis, a disease which contributes to a large number of handicapped persons in early life, is the chief cause of orthopedic impairment among young people and is responsible for one-fifth of all such handicaps.² During the past eight years, the number of young persons crippled by poliomyelitis has increased about 45 per cent. It has been estimated that there are 80,000 persons under 21 years of age in this country who are handicapped by this disease. The number of persons who fail to make adjustment in life due to severe physical handicaps as a result of poliomyelitis, is large enough to constitute a serious medical, social and economic problem. It is urgent therefore, that some solution be found to the problem of disability from injury and chronic illness.

In the past, there has been much speculation concerning the number of persons who have residual disabilities from poliomyelitis, after receiving extensive care and treatment for this condition. Nevertheless there still remains the inability in many persons, to achieve maximum capacity to perform the physical activities inherent in their daily lives, or maintain so-called normal or average educational, social and vocational standards. If this number is large

in a community, it faces the burden of supporting many persons unable to earn a livelihood, unless means are provided to guide and train them in ways of self-sufficiency and self-support. To obtain authentic information on the residual disabilities from poliomyelitis, this study was undertaken in 1953.

Scope and Method of the Study

The purpose of the study was to investigate the effect that poliomyelitis, as a chronic disease, could play as a factor in the prevention of overall adjustments to life of the persons suffering from the sequelae of this disease. It was primarily directed in two fields:

A. Those with residual disability resulting from paralytic poliomyelitis to determine:

1. Whether the disability was connected with:
 - a. Physical difficulties in meeting demands of daily living
 - b. Social limitations
 - c. Limitations of educational objectives
 - d. Limitations of vocational objectives
 - e. Psychological problems
2. Whether further benefits might be received from physical rehabilitation training.

B. Those who had non-paralytic poliomyelitis with evidence of muscle weakness and fatigability.

The study was planned to follow up 362 patients, who over a five-year period, had been reported to the Board of Health, Jefferson County of Kentucky,

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and had been given treatment for poliomyelitis during the years 1947 through 1951. These patients who were surveyed do constitute a representative sample of persons disabled as a result of poliomyelitis. However, the number of cases on which some of these statistical findings are based, is too small for valid generalization. The data nevertheless, affords indications of existing trends in the lives of these persons and reveals conditions and situations that occur repeatedly elsewhere throughout our nation.

Table 1 lists a breakdown of the 362 cases and their original diagnoses which were recorded with the Department of Health of Jefferson County, Kentucky.

**Table 1: Reported Poliomyelitis Cases 1947-1951
Jefferson County, Ky.**

Diagnosis	Total Cases	%
Abortive	94	25.9
Non-paralytic	119	32.9
Paralytic	149	41.2
Total	362	100.0

Of these 362 patients, 178 were interviewed and the study was completed, as shown in table 2.

Table 2: Cases Surveyed and Study Completed

Diagnosis	Surveyed	Not Contacted	Total
Abortive	—	94	94
Non-paralytic	79	40	119
Paralytic	99	50	149
Total	178	184	362

The limits of the study prevented investigation of the 94 original cases listed as abortive in type. An additional 90 cases were not included in this study because of death, change of location, or located in distant regions for rehabilitation treatment. It will be noted that of the cases which were lost because of the reasons listed, 40 of these fell under the classification of original diagnosis, non-paralytic, and 50 cases under the paralytic classification.

The study was made under the direction of a specialist in physical medicine and rehabilitation, with assistance from a senior medical student and a social worker. Each patient, with a parent

whenever necessary, was given an initial interview usually in his or her home, and a detailed post-hospitalization history was obtained, including subjective complaints that might have been associated with poliomyelitis. Each patient was then given a complete muscle test and was thoroughly checked by the physician. In addition to muscular abnormality, the patients were checked for structural and postural changes, including shortening and atrophy of the extremities as measured by accepted techniques. The social worker's observation of the patient's adjustment to his environment, based on his personality and attitudes, were recorded after an interview and visit to the patient's home. Because this part of the study was primarily exploratory in nature it was organized on a simple basis, being wide in scope but limited in depth, and was focused on the social, emotional and psychological effects and recorded as satisfactory, tolerable, and unsatisfactory. It was possible in this way to receive information concerning the main objectives and spheres of physical, mental, social, educational, vocational and psychological patterns for which this study had been originally designed.

Character of the Group Studies— Original Diagnosis—Paralytic

The 99 persons selected for the follow-up portion of this study were those who had original diagnosis of the effects of poliomyelitis from a paralytic standpoint, and who had received hospital or home treatment for residual disabilities for a period of at least two years previous to this survey. Of this group, 59 or approximately 60 per cent of the total number of persons studied were persons who had obtained follow-up therapy from a hospital unit which had a comprehensive rehabilitation medical service, while 40 or more per cent had received their follow-up program either in a unit which did not have such a functioning comprehensive rehabilitation approach or on a home treatment program. Males composed 52 per cent and females, 48 per cent of this paralytic

group. Averages as shown in Table 3, indicate that 80 per cent of these patients were under 15 years of age at the time of onset of the disease.

Table 3: Age at Onset — 99 Paralytic Cases

Age	Total	Female	Male
Under 1 year	6	3	3
1-4 years	37	17	20
5-9 years	21	10	11
10-14 years	16	9	7
15-24 years	10	5	5
25 years and over	9	4	5
Total	99	48	51

A medical examination of the subjects was made to identify the parts of the body affected by the residual paralysis. A part was classified as involved, or a "physical disability" present, if there were limitation of motion, or weakness in conforming to movements required for the activities of daily living. Table 4 reveals that over 74 per cent of the total number had involvement of the lower extremities, while over 34 per cent had both lower extremities affected. It should also be noted that about 12 per cent had 3 or more extremities involved.

Table 4: Distribution of Regions of Body Involved—Residual Paralysis — 99 Paralytic Cases

Part	No. of Cases	%
Lower Extremities	74	74.7
One lower extremity	40	40.4
Both lower extremities	34	34.3
Upper extremities involved	19	19.1
Lower and upper involvement	24	24.3
Three extremities involved	12	12.1
Back, abdominal, face and others	6	6.0

Adjustments of Patients with Disability to "Activities of Daily Living"

Each patient was evaluated by the "test of the physical demands of daily living." This test was adjusted by accepted criteria to meet the testing requirements of all age groups. It consists of approximately 106 activities, over three categories; a) Ambulation and elevation; b) self-care, and c) hand activities. This method gives a rather independent criteria for the evaluation of a patient's adjustment with his physical disability to his environment as well as his psychological acceptance of his disability.

Fifteen of the group could perform these activities in a normal manner with

normal speed. They were classified as having no physical handicap; 71 could perform all the activities but not in a normal manner with normal speed. They were classified as having adequate compensation; 13 were unable to meet the physical demands of daily living and were practically confined to their homes.

It was interesting to note that approximately five times as high a percentage of persons in the home treatment and hospital groups where intensive follow-up care was not possible, had inadequate compensation, as compared with the hospital group, in which comprehensive rehabilitation was part of the medical care program (table 5).

Table 5: Inadequate Compensation Based on Activities of Daily Living Compared to Type—Follow-up Care

Follow-up Program	No. of Cases	Inadequate Compensation	%
Comprehensive rehabilitation	59	3	5.1
Hospital—no rehabilitation	22	4	18.2
Home treatment	18	6	33.3

Prosthetic Appliances

Prosthetic appliances were necessary in 57 of the cases, with 34 persons requiring both braces and crutches or canes (table 6).

Table 6: Prosthetic Appliances — 99 Paralytic Cases

Appliance	No.	%
Used no appliances	42	42.4
Used appliances	57	57.5
Braces — short leg	22	22.2
long leg	32	32.1
Long leg and pelvic band	2	2.0
Long leg and corset	4	4.0
Back	7	7.0
Knee	1	1.0
Cornets	7	7.0
Shoes, corrective	1	1.0
Arm support	1	1.0
Crutches or canes	34	34.3

Social, Educational and Vocational Limitation

The evaluation of social and emotional adjustment as well as limitation of educational, occupational and vocational goals is in effect a judgment as to whether or not the individual or patient was leading an active and contented life. And if not, whether he found his situation to be tolerable or seriously unsatisfactory.

Retardation from an educational viewpoint is listed in table 7. It should be noted that of the total of 42 chil-

dren of school age, falling into this paralytic group, 28 or 67 per cent, had lost some time because of their physical disability due to poliomyelitis involvement. This figure as a whole, presents a challenge to our social and educational program to provide educational facilities for homebound or hospitalized patients, while they are receiving medical care for their disability or illnesses. Comparison of those who received their medical care on a home basis as compared to a hospital program, did not reveal any significant data for the two different units. However a correlation could be drawn from the fact that those patients who had severe handicaps and were homebound for a relatively long period of time, they of necessity, fell into the group of those who had a retardation in their educational process, which existed for some time unless the family was financially able to pay for home tuition.

Table 7: Educational Retardation —
99 Paralytic Cases

	No.	%
Cases retarded	28	28.3
Length of lapse		
3 months	2	2.0
6 months	8	8.1
1 year	14	14.1
1½ years	1	1.0
2 years	2	2.0
3 years	1	1.0
Cases not retarded	71	71.7
Reasons		
Too young	43	43.6
Too old	14	14.1
No ed. lapse	14	14.1
Total	99	100.0

The retardation in the sphere of vocational adjustment is listed in table 8. Of the 16 cases falling into this area of age-group employability, all felt that their vocational adjustments and occupational advancement had been retarded in some manner. Of this group of 16 patients, 10 had regular full-time jobs, 2 had part-time positions and 4 were temporarily unemployed or too severely disabled for work of any type. The 2 doing part-time work, were confined to their homes in which they turned out material for industry on a contract basis. There were no significant differences between the handicapped working in full-time positions and those with no handicap, in respect to type of work performed, type of job or earn-

ings. Percentage of unemployed persons however, decreased markedly in respect to the severity of the handicap.

A larger proportion of persons who had completed high school or received higher education were employed in better paying jobs, than those who did not. It is also significant that most of those who had received vocational training in earlier life, were not employed in the work for which they had been trained.

Of these 16 patients in this class, all felt that their disability prevented their choosing the type of work they desired or hindered them from the standpoint of occupational advancement. Obvious need for vocational guidance was recognized by the whole group. All felt it was the outstanding need of their problem, especially by those who were unemployable.

Table 8: Occupational Retardation —
99 Paralytic Cases

	No.	%
Cases retarded	16	16.1
Cases not retarded		
Reasons		
Too young	82	82.9
Adjusted	1	1.0
Total	99	100.0

For the purpose of evaluating the social life of these 99 individuals who had residual disabilities, resulting from paralytic poliomyelitis, they were divided into 2 groups — under 15 years of age and 15 years of age and above. The group under 15 years of age consisted of 80 individuals whose parents helped in their social evaluation. The group 15 years of age and above consisted of 19 individuals in which the social evaluation was accomplished by questioning the patients. The evaluation of the social and economical adjustments in these cases was a decision as to whether or not the individual was leading an active and contented life; and if not, whether he found his situation to be tolerable or seriously unsatisfactory.

In the group under 15 years of age, it was interesting to find from the parents' standpoint, 25 per cent of these patients had emotional disturbances of various types, which included irritability, emotional lability and instability, as well as difficulty in maintaining social rela-

tionships with children of their own ages. It was also pointed out, that in over 50 per cent of the families in which these cases occurred, the interviewed parent felt the child's disability had an influence on and had changed the home life and social atmosphere.

In the group 15 years of age and above, which consisted of 19 individuals, 10 patients felt that their social life was satisfactory, while 7 felt that their situation was tolerable and 2 reports were unsatisfactory. Of those who felt they did not have a satisfactory social life, all felt their disability was the cause. It should be mentioned here that those patients who were homebound or unemployed, fell into the class of tolerable or unsatisfactory social adjustment, which indicates a correlation between attendance at school and employability. The sex distribution in the groups of tolerable or unsatisfactory social adjustment was predominantly female. Intensive questioning at the time of this survey, revealed that these were teenagers, or young unmarried women who felt that their disability prevented them from acceptance or being offered dates or proposals of marriage.

Only 4 persons of this entire group took part in some organized activity. Ten had hobbies and avocations of their own. Only 4 had any sort of group membership or belonged to a social organization.

Superimposed Disabilities

In a follow-up survey of the 99 cases which had been classified under the Paralytic Group, attention was given to the presence or absence of superimposed disabilities upon that of the original pathology. Table 9 shows the tabulation of secondary involvement in three main areas—back abnormality, limb shortening, in particular the lower extremity, and limitation of motion in various joints of the body.

It will be noted that 26 cases with a back disability had either a scoliosis, lordosis, or kyphosis involvement, which was severe enough to be recorded as a progressive disability. A shortening of

Table 9: Superimposed Pathology — 99 Paralytic Cases

Area Involved	No. of Cases	%	%
No Involvement	48	48.5	
Backs	26	26.3	
Scoliosis	18		18.3
Kyphosis	7		7.0
Lordosis	1		1.0
Extremities, lower			
Shortening	10	10.1	
Joints — Contractures	15	15.1	
Shoulders	12		12.1
Hip	3		3.0
Total	99	100.0	

the lower extremity was present in 10 cases. Limitation in motion about the joints was found in 15 cases, with fibrous contractures being present. It is interesting to note that of these 15 cases, 12 of them were confined to the shoulder areas, while the other 3 were hip involvement.

A correlation between the superimposed disabilities and the hospital, home or follow-up care which these patients had received, revealed that 90 per cent of the superimposed disabilities occurred in patients who did not receive intensive follow-up care, either through a private institution or hospital in which physical therapy and orthopedic medical care were available.

With the knowledge, tools, and techniques currently at our disposal, many of these permanent disabilities could be either minimized or wholly avoided. Granting the apparent inevitability of varying degrees of crippling, due to the nature of the basic pathology, we must recognize the frequency of superimposed secondary pathological changes, and follow through with a medical care program from the standpoint of "Preventive Medicine" or "Preventive Rehabilitation."

Follow Up Non-paralytic Group

In this survey, a total of 79 patients was examined, of whom 64 were children, under 15 years of age, and 15 were adults. Table 10 lists results of this study with distribution of muscular weaknesses as determined by our physical examination and muscle testing procedure.

Muscular weakness was found in 33 patients or 41.7 per cent of the total

Table 10: Follow-Up Non-Paralytic Cases

	No.	%
Total number of cases examined	79	
Total with subsequent muscle weakness	33	41.7
Symptoms referable muscle weakness	9	27.2
Muscle fatigability and irritability	42	53.2
Distribution of muscle weakness		
Quadriceps	13	16.4
Gastrocnemius	11	13.9
Hamstrings	8	5.0
Abdominal muscles	3	3.8
Sternocleidomastoid	3	3.8
Deltoid	3	3.8
Hip Extensors	2	2.5
Triceps	1	1.2
Biceps	1	1.2
Hip flexors	1	1.2
Rhomboids	1	1.2
Anterior tibial	1	1.2

number of patients examined and followed up. In most instances, the major segment involved were those of the weight bearing areas, particularly the gastrocnemius and quadriceps groups. Of this group of 33 patients, 27.2 per cent had symptoms referable to the segments in which the muscle weakness had been detected or localized. Upon severe exertion, such as running, participation in sports, swimming, and other physical activities, 17, or slightly over 50 per cent of this group stated they had muscle pain or extreme fatigability, in the segments which had been found to be weak under examination. At no time did the muscle weakness or extreme fatigability under exertion appear extensive enough to interfere appreciably with the normal activities of the patient. It was the opinion of the examining staff that if the examinations had been carried out after periods of physical activity and exertion it probably would have been possible to demonstrate muscle weakness in a larger group of this segment of the population.

Conclusion

In poliomyelitis, as in most other chronic diseases, patients are left with a residual disability. It is to be expected that some will have little or no handicap in performing the physical activities of daily life. Some will be handicapped, but able to meet the physical demands in an adequate manner. Others will find it extremely difficult to make adequate adjustment. It is felt an adequate follow-up and a comprehensive rehabilitation approach should result in three to four times as many persons making ade-

quate compensation than that which would occur if we "let nature take its course." If the disabled are taught to perform the activities of daily living, it is probable that only 3 per cent could not be trained and employed in positions suited to their abilities and disabilities.⁹

A large majority of disabled persons have the mental and physical capacity to lead normal lives and achieve satisfactory social and emotional adjustments.

Psychological factors are as important as physical factors in the adjustment of the chronically ill or the disabled, and we must be concerned with scientific study and treatment to the same extent as that practiced for the alleviation of physical factors.

In this study, it was felt as a final conclusion that the community resources for social adjustment and physical facilities for aiding the disabled were in most instances, except in individual cases, extremely inadequate for this group studied.

The educational attainment of the persons in this group study, appeared to be closely correlated with the type and degree of physical disability. Those without long periods of confinement in a hospital or at home appeared to suffer little loss in their educational process; however, little planning was recognized at the community level for the education of those receiving long term convalescent or medical care.

All patients in the age group feasible for employment, appeared to feel that their employment, advancement or attainments were retarded by their physical disability. Vocational guidance was listed as one of the most important factors as an obvious need in aid to the physically disabled.

Long term follow-up care is necessary in both the paralytic and non-paralytic classification as evidenced by the muscle weakness and easy fatigability in over 40 per cent of the non-paralytic group.

The presence of superimposed disability should be considered and preventive care given through intensive follow-up study in the application of the newer

tools and technics of medical science.

Lack of social activities for disabled persons appears to be of even greater value in helping in the factors of maladjustment than lack of vocational opportunities or occupational guidance. There appears to be little difference between the sexes regarding extent of disability, education and general adjustment. Women in general, are in a less desirable situation than men relative to employability, economic status, social life, and attitude toward disability, particularly the part it plays in home life.

Among the subjects that should receive future investigation and aid in helping the physically disabled are: Increased opportunities for vocational guidance and training for selective job placement; more intensive community social service activities for the physically handicapped in connection with comprehensive rehabilitation; a study of the emotional needs as a factor in rehabilitation, with particular emphasis on the part that a disabled child plays in the home life of a family structure; a sum-

ming from a community standpoint of the need of educational facilities for homebound and long-term hospitalized patients; intensive follow-up care in all cases of disability for the prevention of superimposed disability, and the establishment on a community basis the working unit of a comprehensive rehabilitation team to work for the chronically disabled; as well as integrate treatment and training activities in the physical, vocational, sociological and economic spheres. Such a program can aid over 90 per cent of those with chronic disease and resulting disability.

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Clinical Application of Therapeutic Relaxation

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Perhaps the most compelling fact of our time, medically speaking, is the recognition and understanding that the wonderfully complex human being is a highly integrated organism which acts and reacts as an indivisible unit. This is demonstrated most dramatically by the bodily changes normally accompanying emotion, so well described by Cannon,¹ and the bodily responses to stress as postulated by Selye.² The teachings of psychological medicine contribute materially to this basic concept. The constant stream of stimuli engendered by emotions, ideas, attitudes, various physical states such as disease and disability, and daily experiences with people and situations, all blend to produce their effects

upon the whole person. It is permissible to assume then that, since the body acts and reacts as a unit, any benefit derived from treatment, either physical or psychological, will be reflected as a gain for the organism as a whole. Of what significance is this to physical medicine and rehabilitation? First, we propose the use of relaxation technics as an invaluable method of establishing rapport between the patient and physician or therapist for the therapeutic benefits inherent in such a relationship. The following suggested relaxation technic con-

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sists of two steps:

- A. **Preparation of patient**—The introduction of the patient to the treatment situation should be a pleasant one. Quite deliberately, the patient is placed in a comfortable position which permits easy access to the part to be treated. The recumbent position is often the preferable one to reduce the efforts of the heart and of the muscles concerned with maintaining the erect position. A pillow or two used as supports and placed to advantage will help further to relieve muscular strain. The important criterion for any position assumed is that the patient feel comfortable.
- B. **Release of muscular hypertonicity**—The proper positioning of the patient is a preliminary to securing general release of muscular tension. After the patient has been settled comfortably on the plinth, there still remains a variable degree of chronic, habitual muscular hypertonicity or spasm induced by the underlying pathology. We have now to seek some method of reducing the muscular hypertonicity.

The technic of relaxation used in our clinic consists of having the patient, while he is in a comfortable resting position, visualize some specific picture or action taking place. One example follows: The patient is asked to pretend there is an opening in the pillow on which the head and neck are resting and then to picture the head and neck gradually sinking lower and lower into the opening in the pillow. This is repeated slowly several times in a low monotone. It is then suggested to the patient that as the head and neck sink deeper and deeper into the opening in the pillow, they feel lighter, softer and easier. The same suggestions are given for the chest and shoulders as a unit, and for the pelvis and lower extremities as a unit. Throughout the procedure, the patient performs abdominal breathing. The entire process is repeated once more. Finally, the patient visualizes the whole body, from the head to the toes, gradually sinking deeper and deeper into the bed, with the body feeling lighter, softer and easier.

In order for the patient to understand what is expected of him, there should be a few words of introductory explanation. This has to do with the importance of lying quietly and comfortably, only visualizing what is suggested. Routinely, the relaxation method takes not more than ten minutes of the first two or three treatment sessions. Thereafter, the placement of the patient in a comfortable position and a short review of the points previously covered are all that is necessary. It is hoped that the early conditioning of the patient will help him naturally to assume a comfortable and relaxed position during the later treatment periods.

The particular method employed in inducing relaxation is relatively unimportant. Any method that brings about a decrease in muscular tension is adequate. It may be possible to accomplish this by some form of heat or by superficial effleurage. The authors' preference, however, is for a method that teaches the patient relaxation rather than one that merely uses passive measures. The relaxation methods require the joint participation of the therapist and the patient, thereby creating a closer therapeutic bond between the two.

Clinical Application

This brings us to the second proposed use of relaxation technics, their use as an

adjunct to other forms of physical treatment. It has been our experience that the indications for relaxation are frequent in many conditions encountered in the physical therapy clinic. This is especially true in acute and chronic disorders of the musculoskeletal system, in which pain and muscle spasm are prominent symptoms. We have found that muscles chronically hyperactive or in spasm are a deterrent to effective treatment. Methods of inducing relaxation offer a means of decreasing muscular tension and thereby increase circulation and relieve pain.

Our experience with over 500 patients with painful shoulders has led us to believe that relaxation methods have an important place in a treatment program. A tuberculous patient, age 47, presents a striking example of how effective relaxation procedures may be at times. This patient developed a severely painful shoulder while on leave from the hospital. He consulted his family physician who advised immediate return to the hospital for whatever treatment was indicated. We were confronted with a haggard, worn-out patient who had spent three sleepless nights. Laboratory tests and roentgenograms of the cervical spine and shoulders were essentially negative. Examination revealed a tense, apprehensive patient with painful and limited motion of the left shoulder girdle. All movements were guarded and the musculature around the joint was in spasm. It was decided initially to do what we could to relieve the pain, and later on to be concerned with shoulder motion. The patient was placed in the supported right side-lying position, with the left shoulder girdle exposed. Relaxation was given as described, followed by infrared of low intensity and superficial effleurage. The patient remained resting for thirty minutes, quite relaxed and comfortable, and then returned to the ward. The next morning, much to our surprise, the patient appeared quite changed. He had slept well and the strained look of anguish was gone. The treatment of the previous day was repeated and in addition

gentle movement of the shoulder was instituted. Motion was much freer but still limited. After a total of six treatments, the patient could perform the full range of shoulder movements painlessly.

This patient is presented not as the usual shoulder case nor as the usual result of treatment. He does illustrate, however, the influence of certain psychological factors upon the severity of symptoms and upon the outcome of treatment. We feel that the patient's response to the shoulder pain was an exaggerated one, judging from the paucity of pathological findings and from the prompt relief of pain. Further, the type of treatment given was effective in relieving the shoulder pain because it satisfied a psychological need of the patient. This will be discussed at greater length in a later section.

Interestingly enough, Coventry⁸ speaks of "the periarthritic personality" and describes such a person as having a low threshold for pain, showing a hyperresponse to pain stimulation, and displaying hyperirritability and muscular tenseness. Lorenz and Musser⁹ observed that in the sixty patients studied by them, "the onset and course of shoulder symptoms in these patients were intimately related to certain of their emotional reactions and stressful life situations," and they suggested that the sustained increase of muscular tension resulting from emotion was directly related to the pathogenesis of painful stiff shoulder.

We wish to indicate here that often there is a psychological component of varying degree in our patients with painful shoulders and that this, as well as the lesion itself, needs attention.

In the treatment of recent injuries, or after removal of casts, or in chest surgical patients, relaxation procedures in a somewhat modified form are particularly effective in easing the traumatized muscles and in mobilizing the associated joints, when indicated. One modification of relaxation technic consists of having the patient visualize movement of the involved joint without voluntary contraction. For instance, to mobilize a

knee joint after removal of a plaster cast, the patient sits over the side of the bed with the weight of the affected leg supported by the therapist. The patient is then asked to pretend that a ten pound weight is tied to the ankle and to visualize the weight gradually drawing the leg downward, being careful not to contract any of the muscles around the knee. The purpose here is to relax the quadriceps so that the extended knee gradually may be flexed passively.

We feel that our chest surgical patients are materially benefited by being taught how to decrease the tension in the incised muscles around the thorax, and then how to breathe diaphragmatically, which further helps to relax the thoracic and abdominal musculature.

The treatment of low back conditions, in which we have had experience with 271 patients, is somewhat similar to that of painful shoulders. Holmes and Wolff¹⁰ state that "Although the etiology of the backache syndrome has not been clearly established, it appears that sustained contraction of the skeletal muscles plays an important role in its genesis." In our experience, the effectiveness of treatment depends upon the degree of muscular relaxation secured, by whatever method employed. This is essentially what Price, Clare and Ewerhardt¹¹ found in their "Studies in Low Backache with Persistent Muscle Spasm." We believe that relaxation technics are indicated in low back conditions as an important adjunct to other forms of physical therapy.

We have found comfortable positioning and relaxation methods useful in the treatment of 156 arthritic patients, forty-two of whom were afflicted with rheumatoid arthritis. The latter group were patients with co-existent pulmonary tuberculosis in whom cortisone and ACTH were contraindicated. A close relationship has been established between personality factors and the physical manifestations of rheumatoid arthritis.^{12,13} It is our strong conviction that as much can be done for these patients by the warmth and interest we are able to convey to them as with the various

physical measures employed.

Then there are various transitory muscular pains and aches of vague origin, such as myofascitis, fibrositis and myalgia, which are often helped by relaxation combined with other physical methods of treatment.

And, of course, we should not forget the many patients we see daily who spend long periods of time in bed. For them, relaxation and comfortable positioning during daily bed activity are prime requisites for gaining the benefits of bedrest.

Contraindications

The contraindications of the relaxation procedure as presented herein are two in number and they are essentially psychological in nature. The first is represented by the type of patient who feels that what he really needs is "a good rubdown." For him treatment must be vigorous to be effective. Relaxation techniques are of little value for such a patient. The second contraindication is for the patient who expresses fear that he may be hypnotized by the therapist. It is well to try standard methods of treatment when one encounters such feelings on the part of a patient. In order that relaxation methods may be of benefit, the patient must cooperate. If for any reason this is not possible, it is best not to attempt these techniques at all.

Rationale of Relaxation Procedures

If, by means of relaxation techniques, we are able to relieve pain and discomfort and thereby promote the patient's feeling of well-being, the psychological counterpart of physical well-being reinforces the physical benefits attained. More important, however, is this consideration: If the patient can be made to feel, through these very deliberate efforts at making him more comfortable and relaxed, that the physician or therapist is genuinely interested in his welfare, the physical and psychological benefits are greater than those achieved by any relaxation methods, *per se*. This is because we have been able to satisfy an emotional need of the patient, which

is an integral part of his psychosomatic response to the illness or disability.

The armamentarium of the specialist in physical medicine and rehabilitation consists essentially of physical means of treatment, with a minimum of exhortation and verbalization designed to influence the patient psychologically. Considerate handling of the patient will speak more effectively than words, and motivation for improvement will often be evoked quite spontaneously. Words to convey a feeling of warmth and interest are desirable, but the injudicious choice of words by those of us who are not psychologically orientated in their use may easily upset the therapeutic relationship. Frequently we are unable to foretell just how the patient will interpret or react to the information given him. A safer course lies in the direction of *doing* rather than of saying.

Summary

Proceeding on the concept of the essential unity of the human organism, two suggested uses for relaxation methods were given for the purpose of obtaining the psychological and physical benefits inherent in these methods. First, the relaxation procedures may be used to establish rapport between the patient and the physician or therapist. Second, they may be used to enhance the effects of treatment when given in combination with other physical measures. The authors wish to encourage the routine application of comfortable positioning and relaxation whenever indicated, and such indications are frequent.

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Source of a Type of "Insertion Activity" in Electromyography with Evaluation of a Histologic Method of Localization*

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To understand more fully the significance of the electromyographic patterns associated with neuromuscular disorders, correlation of electric activity with the histologic appearance of the muscle is necessary. In the past this has been done only in a general way. Since the pathologic changes in diseases of muscle vary from one area of the muscle to another, a more precise identification of the tissue giving rise to specific types of electric activity is desirable. One purpose of this paper is to describe a method for locating in histologic sections the area from which records of electric activity have been made. The method is an adaptation of one used by Marshall¹ and by Adrian and Moruzzi² for brain tissue. Iron is deposited in the tissue at the tip of a needle electrode by passing a current through the needle. Subsequently, the location of the needle in the tissue can be identified grossly or in histologic sections by staining the iron with potassium ferrocyanide.

To evaluate this method it was necessary to select for localization a specific type of electric activity, the source of which was known with reasonable certainty. Selection was made of a type of electric activity which is occasionally de-

tected in normal muscle at rest and which presumably arises from intramuscular nerves. Evidence suggesting that this electric activity does arise from nerves and the results of histologic localization of the source of this activity are presented.

Since the electric activity herein described is evoked by the insertion of a needle electrode into certain areas of muscle, it may be classed as one type of "insertion activity" encountered in electromyography (Kugelberg and Petersén).³

Methods

Electromyographic examinations were carried out in the conventional manner using a needle electrode for detection and a cathode-ray oscilloscope and loudspeaker for observation of variations of electric potential. For critical experiments concerned with localization, the electrode was of the unipolar type (Jasper and Ballem)⁴ consisting of a steel needle (0.5 mm. in diameter) coated with an insulating plastic (tygon) except

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for a fraction of a millimeter at its tip. A metal plate (2×4 cm.) on the surface of the skin or a bare needle inserted beneath the skin (in animals) served as a reference electrode. The amplitude response of the amplifier to a sine-wave input of constant amplitude was down 3 decibels at 15 and at 5,000 cycles per second when the source impedance was equivalent to that of the needle electrode. Records were made by photographing the oscilloscope screen with a 35 mm. camera.

For stimulation of muscle through the recording electrodes, a square-wave stimulator was connected to the needle electrode (cathode) and reference electrode (anode). Single impulses 0.2 millisecond in duration were used.

The technic for marking the tissue at the tip of the needle electrode, so that it could be identified later in histologic sections, was as follows: The recording electrodes were connected to a source of current consisting of a 45-volt dry cell and a potentiometer. The needle electrode was connected to the positive pole; the reference electrode to the negative pole. A 0-100 microampere meter was in series with the electrodes. The current passing through the needle was increased gradually from 0 to 95-100 microamperes and was maintained at that level for 45 to 55 seconds.

Precautions were taken to minimize movement of the needle between the time that the electric activity was recorded and the time that iron was deposited. The change of electrode connections from amplifier input to the source of current used for depositing iron was made quickly by snapping a single switch. The flow of current was increased gradually to minimize the possibility of stimulating the muscle and causing movement of the needle tip.

After current flow was stopped, the muscle surrounding the needle was excised and placed for a period of 12 to 24 hours in Ringer's (mammalian) solution containing 1 per cent potassium ferrocyanide and 10 per cent formalin. The area containing the iron deposit became bluish green. The tissue was

then embedded in paraffin. Serial sections through the area of iron deposition were stained with hematoxylin and eosin. Satisfactory iron deposits could usually be located grossly in the excised tissue, yet were not so large that they lost specificity nor so intense that coagulation destroyed the histologic details. The deposits were approximately 150 to 300 microns in diameter on cross section with a longitudinal extent of approximately 800 microns. The area varied with the total current and the size of the bare tip of the needle electrode. Steel sewing needles (Number 8 sharp needle, diameter 0.5 mm., manufactured by Boye Needle Co., Chicago) coated with tygon were used as electrodes. Optimal spots were obtained when 0.2 to 0.3 mm. of the tip of the needle was bare.

Results

Occasionally during electromyographic examination of normal muscle at rest, the exploring needle electrode enters an area from which a distinctive type of electric activity is recorded (fig. 1). This activity has two components (fig. 1D).

The first is a low-amplitude component (5 to 20 microvolts) which appears as an increased irregularity of the base line on the oscilloscope and has an accompanying sound which is slightly lower in pitch than the inherent noise of the amplifier. It has been characterized as the "sound of a sea shell."

The second component consists of a variable number of spike potentials which have a short duration (2 to 4 milliseconds) and low amplitude (10 to 500 microvolts) and are usually diphasic with an initial sharp negative phase (0.5 to 1.5 milliseconds) and a second slower positive phase (1 to 3 milliseconds). Less frequently, these potentials are monophasic or triphasic with the principal spike being negative (fig. 1G). They may occur singly or more often in rapid succession, and usually with an irregular rhythm. Slight pressure on the needle may greatly increase the number and frequency of the potentials, causing them to occur in

sporadic bursts or showers. The sound produced is high-pitched.

Either component of the electric activity just described may occur alone, but most often the two are combined as sharp spikes on an irregular base line. Hereafter, for convenience, this activity will be referred to as "nerve" potentials.

Electric activity of this type has been observed in hundreds of persons during the course of routine electromyographic examinations, as well as in many animals including the rat (fig. 1F), guinea pig, cat, dog, rabbit and monkey. In man, it may be observed in 5 to 10 per cent of routine insertions of the needle into normal muscle. It may be observed with either a unipolar or coaxial electrode. It is observed more frequently in some muscles, as for example the interossei, than in others. It is observed more frequently in the region of the motor point than in more distal areas of a muscle. It

is not under voluntary control.

The occurrence of "nerve" potentials is usually accompanied by an acute pain. Both pain and electric activity will persist for many minutes provided the examining needle is not moved. The slightest withdrawal of the needle will abolish both the electric activity and the pain. Returning the needle to the same area may reproduce both phenomena. Such manipulations demonstrate that the source of the electric activity and pain is minute.

Occasionally there is a brief twitch of a strip of muscle in the area of insertion as the needle electrode enters an active zone.

Because of the associated pain and twitch and the minuteness of the area from which these potentials were recorded, it was suspected that this activity originated in or near small intramuscular nerves, probably as a result of

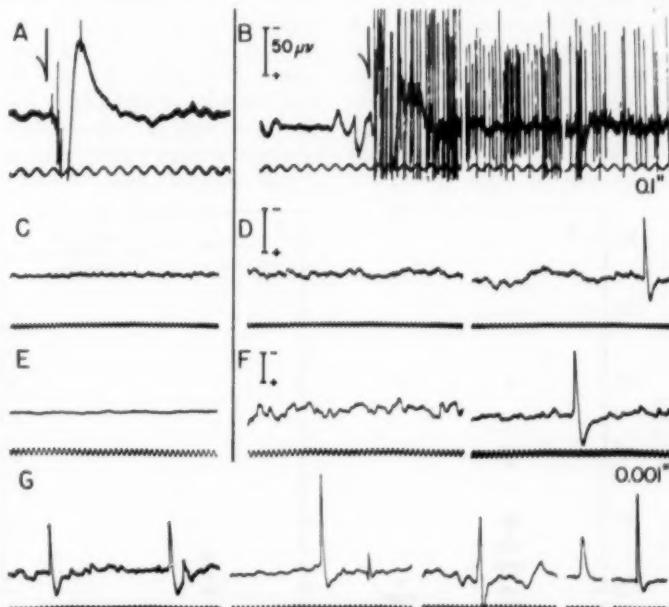


Fig. 1 — Normal muscle at rest. A: Response to insertion of needle electrode into "silent" area of muscle (at arrow). B: Response to insertion of needle into "active" area of muscle. Prolonged discharge of "nerve" potentials. In A and B the time line is 10 cps. In C, D, E, F and G the time line is 1,000 cps. C and E: Detailed picture of base line in "silent" area. D and F: Detailed picture of base line and spike components of "nerve" potentials in "active" area. G: Detailed pictures of "nerve" potentials. A, B, C and D are in man. E and F are in rat. G is from both man and rat. All calibration scales are 50 microvolts. An upward deflection indicates negativity of the needle electrode.

excitation of the nerve by the needle electrode. This hypothesis has been tested experimentally.

Electric Stimulation

If "nerve" potentials arise from intramuscular nerves, areas in which these potentials appear should have a lower threshold to electric stimulation than other areas in the muscle which are electrically silent. To determine whether or not this was true, observations were made on the calf or anterior tibial muscles of rats anesthetized with pentobarbital sodium. The needle electrode was inserted into several areas of the muscle. When areas were encountered that produced either the characteristic irregular base line, the recurrent spike potential or both, the recording electrodes were connected to a stimulator. Using the needle electrode as cathode, the stimulating voltage required to produce a minimal visible contraction was noted. The procedure was repeated when the needle was in a silent area. Eighty such readings were made in four animals (fig. 2A). In general, less voltage was required to elicit a minimal visible response when the needle was in or near an area of "nerve" potentials than when it was in an inactive area (mean for

active areas, 0.32 volt; mean for silent areas, 0.84 volt). In one animal the muscle was exposed so that the response could be more readily perceived (fig. 2B). In this animal the threshold voltages were less in every instance in the electrically active areas than in the inactive areas. The lower threshold occurring in "active" areas suggests that in these instances low-threshold neural tissue was relatively close to the needle tip.

Denervation

If the "nerve" potentials arise from intramuscular nerves, they should not occur following degeneration of the nerve. To determine whether or not this is true, the effect of denervation on the occurrence of these potentials was studied.

In 16 rats the sciatic nerve of one leg was sectioned through an incision in the upper third of the thigh. The sciatic nerve of the opposite leg was similarly exposed, but not sectioned. At intervals of time varying from $4\frac{1}{2}$ hours to 208 hours (8 $\frac{1}{2}$ days), the rats were anesthetized with pentobarbital sodium and the occurrence of "nerve" potentials was observed during multiple insertions of a needle electrode into the anterior tibial

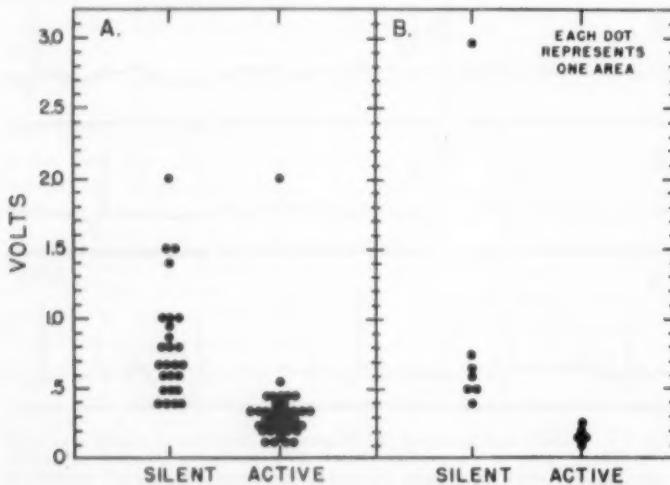


Fig. 2 — Comparison of voltage required to cause a minimal contraction of anterior tibial or calf muscle of rats when the needle electrode was in areas which were electrically "silent" and in areas which were electrically "active" (producing "nerve" potentials). A: Observation through the intact skin. B: Observation of the exposed muscle.

muscles. Observations were made by an individual who had no knowledge of which leg had been denervated. A standard procedure for exploring a muscle by multiple insertions of the needle electrode was found essential to obtaining uniform results. The needle was inserted and advanced in steps to several depths of the muscle. This procedure was repeated until a total of approximately 80 points in the muscle, equally divided between proximal, middle and distal portions, had been tested. The number of points at which "nerve" potentials were observed was recorded. It was observed that the frequency of occurrence of "nerve" potentials was related to the size of the exposed tip of the needle electrode. "Nerve" potentials were observed infrequently when needles with a very small tip (less than 0.1 mm. in length) were employed. Consequently, needles with a relatively large bare tip (0.5 to 1 mm. in length) were used in this particular study. The same needle was used to examine both the innervated and denervated muscle in each animal.

In 1,303 points tested in the intact muscles of 16 rats, "nerve" potentials were encountered 262 times, an average occurrence rate of 20 per cent. Values

ranged from 15 to 27 per cent in individual rats (fig. 3). No change was observed in the frequency of occurrence of "nerve" potentials in the denervated muscles during the first 15 hours after nerve section. At 20 hours, a distinct decrease in the incidence of "nerve" potentials occurred. After 24 hours, these potentials were not observed except at one site in one animal ($38\frac{1}{2}$ hours after denervation). At the time that "nerve" potentials could no longer be evoked, the response of the muscle to stimulation of the peroneal nerve, a few millimeters from its entrance into the muscle, was greatly diminished (1 per cent of normal response).

Fibrillation potentials were not observed in the denervated muscle until several hours after the disappearance of "nerve" potentials. Fibrillation potentials were observed in only one area at 49 hours after nerve section, but increased in number progressively thereafter. At 75 hours, the multitude of fibrillation potentials made identification of any other potentials impossible.

Intensity-duration curves were plotted for each of the denervated and intact muscles at the time of electromyography. A slight decrease in excitability

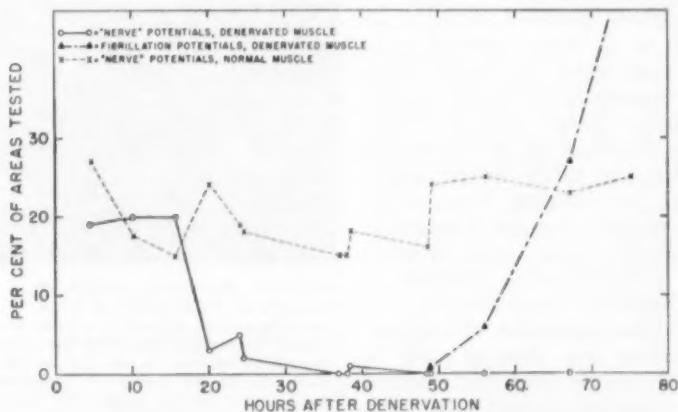


Fig. 3 — Relation between disappearance of "nerve" potentials and appearance of fibrillation potentials in the anterior tibial muscle of rats following section of the sciatic nerve. Approximately 80 areas were tested in each muscle. The per cent of areas showing fibrillation potentials and "nerve" potentials is shown on the ordinate. Each set of points at any hour represents observations on one rat. Crosses represent "nerve" potentials in the innervated leg. Circles represent "nerve" potentials in the denervated leg. Triangles represent fibrillation potentials in the denervated leg.

of the muscle to electric impulses of short duration (1 millisecond or less) was observed in one muscle 20 hours after section of the nerve. However, muscles tested between 24 and 40 hours showed no definite abnormality. A consistent slight decrease in excitability did occur in muscles denervated for 48 to 75 hours, starting just prior to the definite appearance of fibrillation potentials. Markedly abnormal curves characteristic of completely denervated muscles did not appear until after 75 hours, when fibrillation was also marked.

The fact that "nerve" potentials fail to appear in the muscle at a time when the peripheral nerve is inexcitable but prior to the appearance of fibrillation potentials and definite abnormality of the intensity-duration curve further supports the view that these potentials arise from intramuscular nerves.

Histologic Localization

Since clinical observations had indicated that "nerve" potentials occur in relatively minute, discrete areas in the muscle, attempts were made to locate and examine the source of these potentials histologically. The calf and anterior tibial muscles of anesthetized rats were examined electromyographically with the needle electrode. Using the technic already described, iron was deposited at the tip of the needle at points in the muscle which were to be identified subsequently in microscopic sections of the tissue. In one series of muscles iron was deposited in 24 "electrically silent" areas in which "nerve" potentials were not observed. In a second series of muscles, iron was deposited in 28 "electrically active" areas in which "nerve" potentials were observed on electromyographic examination.

Microscopic examination of serial sections through iron deposits made in areas of the muscle which had produced "nerve" potentials revealed small intramuscular nerves within the iron deposit in 22 of 28 "active" areas (fig. 4). No other structures of muscle, including muscle spindles, had any consistent relationship to the area containing the iron deposit. A similar examination of

deposits which had been made in "silent" areas of the muscle revealed nerves within the iron deposit in only 3 of 24 such areas.

When the area immediately adjacent to the iron deposit was examined, small nerves were found within 150 microns of the deposit in 3 "active" areas and 2 "silent" areas. Therefore, nerves were found within or immediately adjacent to iron deposits in 25 of 28 "active" areas, but in only 5 of 24 "silent" areas.

The intramuscular nerves observed within the areas which gave rise to "nerve" potentials varied in diameter from 30 to 100 microns.

Two factors may explain why nerves were not present within the iron deposit in 6 of the "active" areas, while nerves were present in 3 of the "silent" areas. First, although precautions were taken to avoid movement of the needle when iron was deposited, occasionally some twitching of the muscle did occur. This was particularly true when iron was deposited in "active" areas, presumably because of the low threshold of the nerve to electric stimulation. Contraction of the muscle might easily move the needle from its position near a nerve

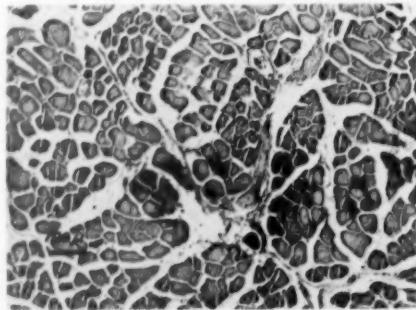


Fig. 4 — Microscopic section of an area of the anterior tibial muscle of a rat. The section contains an iron deposit at a point from which "nerve" potentials were recorded just prior to deposition of iron at the tip of the needle electrode. In the center of the section is a small intramuscular nerve (50 microns diameter) which enters the deposit from the upper right hand corner of the photograph. In serial sections, the nerve passes through the center of the iron deposit and sends branches along septa running in the direction of the upper and lower left hand corners of the photograph. There is a muscle spindle in the upper center portion of the photograph, 175 microns from the iron deposit.

in an area which had shown "nerve" potentials. Second, there is the possibility that in "silent" areas the recording electrode may be immediately adjacent to a nerve without making contact sufficient to evoke "nerve" potentials. This may account for the occasional appearance of a nerve in the iron deposit made in a "silent" area and also for the variable and sometimes low electric threshold of "silent" areas (fig. 2A). In this regard it is of interest that no nerves were present in or near iron deposits made in 7 areas which not only were "silent" but also had a high threshold to electric stimulation.

Despite these sources of error, the observations do support the view that "nerve" potentials are associated with proximity of the needle electrode to small intramuscular nerves.

Comment

Undoubtedly the electric activity which is referred to in this paper as "nerve" potentials has been observed by many persons during routine electromyographic examinations. There are several references to it in the literature. Snodgrass and Sperry⁵ observed action potentials of very short duration in the muscles of normal human subjects. They noted that these potentials were similar to the discharges in mammalian motor nerve fibers. Jasper and Balle⁶ observed similar potentials which "were usually associated with a particularly acute pain." They suggested that these potentials arose from "nerve filaments" and observed that similar potentials occurred when a needle was deliberately inserted in a nerve. Kugelberg and Petersén,⁷ in a study of "insertion activ-

ity" in electromyography, occasionally observed persistent repetitive activity following insertion of the needle electrode into resting normal muscle. They suggested that this was "probably induced by mechanical stimulation and injury of muscle fibers and intramuscular nerve branches." They cautioned that this activity may be indistinguishable from either fasciculation or fibrillation. Reid⁸ observed similar activity in the extraocular muscles of cats and goats.

In each reference, spike potentials are described which resemble the spike component of "nerve" potentials described in this study. The character of these potentials and certain phenomena associated with them have suggested a relationship to intramuscular nerves. None of the descriptions have mentioned the second component of "nerve" potentials which appears as an increased irregularity of the base line on the oscilloscope. It is possible that the latter represents the summation of a continuous and relatively asynchronous discharge of single nerve fibers, while the spike component represents the synchronous discharge of a number of nerve fibers.

Recognition of "nerve" potentials is important chiefly to avoid confusion of the spike component with the fibrillation potentials of denervated muscle. Both potentials have a short duration and relatively low amplitude and occur in resting muscle. However, there are some distinguishing features (fig. 5). The initial deflection of the "nerve" potential is usually negative, while the initial deflection of the fibrillation potential is usually positive. "Nerve" potentials are most commonly diphasic, while the fibrillation potential is most commonly

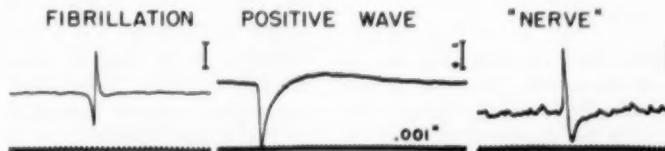


Fig. 5 — Comparison of fibrillation potential and positive wave of denervated muscle with "nerve" potential of normal muscle. All calibration scales are 50 microvolts. The time line is 1,000 cps. An upward deflection indicates negativity of the needle electrode.

triphasic. The rhythm of the "nerve" potential is usually irregular and sporadic in contrast to the usually more regular, leisurely rhythm of the fibrillation potential. The sound produced by the "nerve" potential is pitched slightly higher than that of the fibrillation potential. Positive waves (Jasper and Ballem)¹ are commonly associated with fibrillation potentials, but are infrequently seen with "nerve" potentials. The spike component of "nerve" potentials usually occurs with a second component, a characteristic irregularity of the base line, which is not usually associated with fibrillation. The frequent association of pain with the occurrence of "nerve" potentials is another feature which is useful in distinguishing them from fibrillation potentials.

On the basis of knowledge of the form of action potentials propagated in a conducting medium (Lorente de Nò),⁷ certain deductions about the origin of "nerve" and fibrillation potentials can be made. The usually diphasic form of the spike component of "nerve" potentials, with the initial spike negative, suggests that the spike represents an impulse which originates at the site of the recording electrode. The usually triphasic form of the fibrillation potential suggests, on the other hand, that this potential represents an impulse which originates at some distance from the electrode and approaches and passes the electrode. These deductions are in harmony with the observation that fibrillation potentials originate in the region of the motor end plate and are propagated along the length of the muscle fiber (Jarcho and co-workers)⁸ and with the hypothesis that "nerve" potentials originate at the site of irritation of a nerve by the needle electrode.

The procedure of depositing iron at the tip of the needle electrode proved to be a valuable aid in demonstrating histologically the proximity of small intramuscular nerves to the needle electrode in areas of muscle from which "nerve" potentials were recorded. The procedure is one which should be ex-

ploited further in studies of the electric activity of muscle.

In our own laboratory this procedure has been used as an aid to study the electric activity of muscle subsequently removed by biopsy. Electromyograms have been made in 45 patients by inserting a needle electrode into muscle exposed at the time of biopsy. After the electric activity was recorded, iron was deposited at the tip of the needle and that area of muscle was removed for histologic examination. Because of the variety of histologic pictures observed in this study, no detailed correlation of electric activity can be made from the number of specimens thus far examined. However, some general observations are of interest.

Despite precautions which were taken to remove muscle which included the area in which the iron deposit was made, the iron deposit was identified subsequently in only 23 of 50 biopsies. Success in recovery of the iron deposit increased with experience and changes in technic. In view of the difficulty encountered in recovering these areas under relatively ideal conditions, it seems unlikely that one can with any certainty remove at biopsy the piece of muscle from which electromyographic recordings were made at some previous time, even though the skin at the site of needle puncture has been marked to identify the area tested.

Even though the general area may be obtained at biopsy, the condition of the muscle may vary from point to point so that unless the precise position of the electrode is known, correlation of electric activity and histopathology is difficult. The value of being able to identify the location of the needle is illustrated in figure 6. The electric activity recorded at the time of biopsy was essentially normal. Subsequent study of microscopic sections showed the position of the needle, identified by an iron deposit, to be surrounded by normal muscle fibers. One millimeter away, in the same section, was a fasciculus in which all muscle fibers were markedly atrophic.

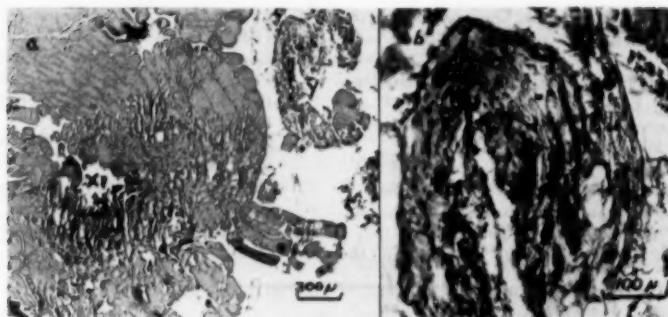


Fig. 6 — Microscopic section of an area of quadriceps muscle removed at biopsy from a patient with muscular atrophy. The section *a* contains an iron deposit (*x*) made in an area from which a normal electromyogram was recorded. This area is surrounded by normal muscle fibers. In the upper right hand corner of the photograph approximately 1 mm. from the iron deposit is a fasciculus with markedly atrophic muscle fibers (*y*). Section *b* is an enlargement of that fasciculus.

Summary

During routine electromyographic examination of resting normal muscle with a needle electrode, relatively minute areas are encountered which produce a unique electric activity. This activity has two components: An irregular, low-voltage oscillation which appears on the oscilloscope as an increased irregularity of the base line, and sharp spikes which occur with an irregular rhythm.

Usually, acute pain and often a brief twitch of the muscle are associated with this activity, suggesting that it originates from intramuscular nerves. For this reason the activity has, for convenience, been termed "nerve" potentials.

Areas of muscle which produce "nerve" potentials have a lower threshold to electric stimulation than other areas of muscle.

After section of the peripheral nerve, "nerve" potentials fail to appear when the peripheral nerve becomes inexcitable. This occurs several hours prior to the appearance of fibrillation potentials and prior to the appearance of consistent abnormalities of the intensity-duration curve.

A method of electrically depositing iron at the tip of the needle electrode was used to identify, in microscopic sections of muscle, areas from which electric activity was recorded. Intramuscular

nerves (30 to 100 microns diameter) occurred with a high degree of regularity within iron deposits made in areas from which "nerve" potentials were recorded, but occurred infrequently within iron deposits in other areas.

Thus, clinical, physiologic and histologic observations support the hypothesis that "nerve" potentials arise from irritation of small intramuscular nerves by the tip of the needle electrode.

Confusion of "nerve" potentials with the fibrillation potentials of denervated muscle can be avoided for the most part by recognizing certain characteristic features of these two types of electric activity.

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For reprints, write Section of Publications, The Mayo Clinic, Rochester, Minn.

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Influence of Some Physical Chemical Factors on Iontophoresis Using Radio-Isotopes

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Iontophoresis may be defined as the process wherein substances in solution are applied to the surface of the body and introduced into the tissues by the use of electric current. Turrell¹ stated that such a form of medication was described in 1747 by Veratti. We became interested in this technic a few years ago in regard to the mechanism of action of iontophoresis. According to our previous results, Oester, et al.^{2,3} and O'Malley, et al.⁴ we concluded that iontophoresis involves the combination of introduction into the tissues by electric current followed by dissemination by way of the circulation. This led to our present study regarding the influence of various physical chemical factors on the initial introduction of a substance by the electrical current. We considered such physical chemical factors as pH, ionic strength, current strength, duration of iontophoresis, concentration, and particle size. It might be mentioned here that a review of the literature indicated that various research investigators had attempted to ascertain what effects these various physical chemical factors had on iontophoresis. However, their results were based mostly on clinical observations rather than on a quantitative estimation of the amount of material introduced. Therefore, we endeavored to undertake a more quantitative approach

regarding the possible influence of these factors on the iontophoretic process, with the use of radioactive tracer substances.

Materials and Methods

The radio-isotopes used were obtained from the Oak Ridge National Laboratory, Oak Ridge, Tenn., and from Abbott Laboratories, Chicago. Most of the experiments were performed with the use of P³². The radioactive phosphorus was obtained in solution form as a phosphate. Two dilutions of this stock solution, as delivered, were made: 0.1 ml. of the stock solution diluted to 100 ml. with distilled water, and 1.0 ml. of the stock solution diluted to 100 ml. with distilled water. Radioactivity counts were taken on both of these diluted samples, and such counts were used as a basis for calculating the percent uptake of the radioactive material by the animal. It would be well to point out the small quantity of radioactive phosphorus, in terms of weight, which was used at the driving electrode in iontophoresis. Fifty microcuries of P³² are approximately equivalent to a weight of

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1.8×10^{-7} micrograms of phosphorus. In certain experiments, albumin labeled with I^{131} and colloidal gold (Au^{198}) were used.

Normal adult rats were selected as the experimental animal. They were under pentobarbital anesthesia, 30 to 50 mg./kg., administered intraperitoneally. The electrodes consisted of platinum wire bound around a piece of moistened cotton and attached to the body of the rat, and were held in place with wires from a current source. An electrode, which we call the driving electrode, was applied to the left front leg, and the second electrode, called the receiving electrode, was applied to the right rear leg. A glass cylinder was slipped over the cotton and the wire of the driving electrode, and was sealed with paraffin at the shoulder area. A Golseth-Fizzell Constant Current Generator was used as the current source. For all experiments, with the exception of those where current strength and duration of current were varied as part of the experiment, we employed five milliamperes of current strength for one hour. Figure 1 indicates the electrode arrangement used.

In the case of radioactive phosphorus

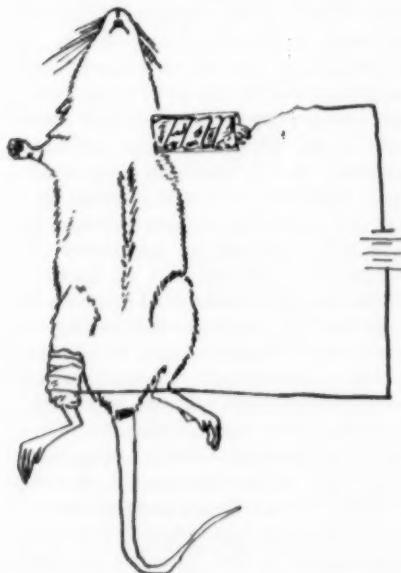


Fig. 1 — Conventional arrangement used in iontophoresis.

(P^{32}) and colloidal gold (Au^{198}) tissue samples were taken at the end of the experiment, digested with 10 N sulfuric acid, diluted up to volume, and an aliquot taken and placed in a porcelain capsule. The sample was counted in this liquid state by a thin end window Geiger Mueller tube and a Tracerlab Auto-scaler. With I^{131} labeled albumin, the samples were treated as described, except 30 per cent potassium hydroxide was substituted as the digesting agent in place of the sulfuric acid.

Results and Discussion

In our experiments, change in pH of the fluid at the driving electrode produced only insignificant effects on the uptake of radioactive phosphorus by various tissues. Figure 2 illustrates these experiments. The report of Abramson, et al⁹ agrees with this finding, while others^{10,11,12} do not.

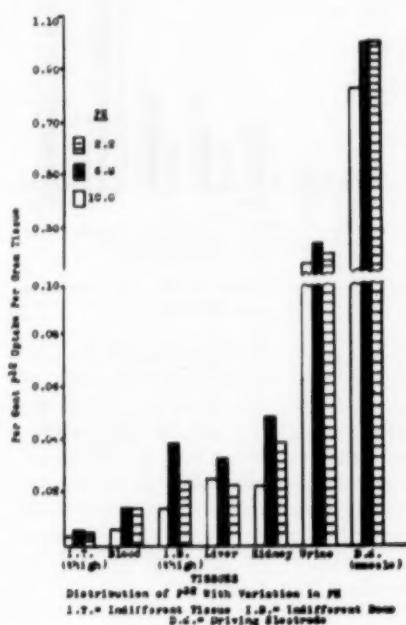


Fig. 2—Distribution of P^{32} with variation in pH.

This and all succeeding bar graphs represent the average values obtained from three identical experiments. We can conclude that under the conditions of our experiment, pH did not appear

to have a significant influence on the transport of P^{32} by the iontophoretic process.

Ionic Strength

It was found that an increase in ionic strength of the driving electrode fluid resulted in a lessened uptake of P^{32} by the tissues after iontophoresis. This effect is indicated in figure 3. Only one other reference⁵ to the effect of ionic strength was found in the literature.

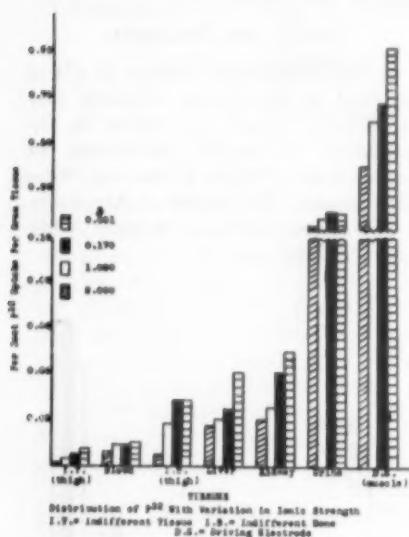


Fig. 3 — Distribution of P^{32} with variation in ionic strength.

Such a result can be explained by considering that as the ionic strength of the medium is increased, the interionic attraction increases between the environment and the ion we wish to introduce. Since the atmosphere around the ion has a charge opposite to the ion, it will exert a retarding effect ("drag effect") upon the motion of the ion that we wish to introduce into tissues.

Current

It was demonstrated that an increase in current strength resulted in an increased per cent uptake of P^{32} by various tissues after iontophoresis (fig. 4). This finding is in conformity with a number of similar observations in the

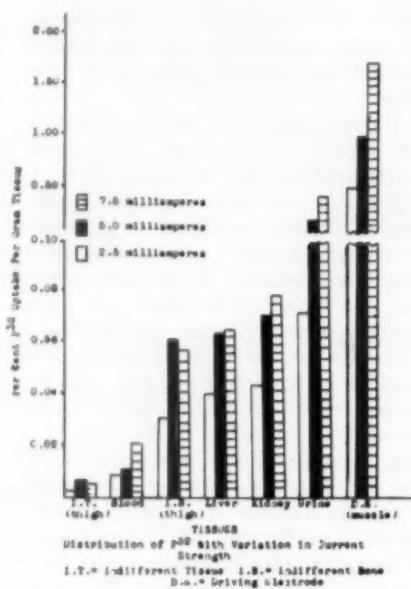


Fig. 4 — Distribution of P^{32} with variation in current strength.

literature.^{6,7,9,10,12,14,15,17,18,21,24,26-30,32,35,37,38}

These experiments demonstrated that with an increase in current strength there was a greater introduction of the radioactive phosphorus in the various tissues. This can be explained partly on the basis of Faraday's Law which, in essence, states that the amount of material deposited at either electrode, therefore taking part in the electrical transport, is proportional to the quantity of electricity which passes through a system. Therefore, one can visualize that with a greater current flow the amount of material that will be transported will be greater. The amount of material driven into the tissues would not necessarily conform exactly to the amount expected under Faraday's Law. In addition to the battery cell reaction, which Faraday's Law embraces, there is a vital membrane phenomena operating when tissues are involved. However, it appears, on the basis of our experiments, that the amount of material deposited in the tissues of the rat by iontophoresis is roughly proportional to the quantity of electricity that we applied, although this is not a direct linear relationship.

When the duration of current flow for iontophoresis was varied, it was found that the longer the duration of current, the greater was the per cent uptake of radioactive phosphorus by the tissues (fig. 5). Again, many literature reports agree with this statement.^{7,9,10,12,14,15,17,18,21-24,27,29-35,37,38}

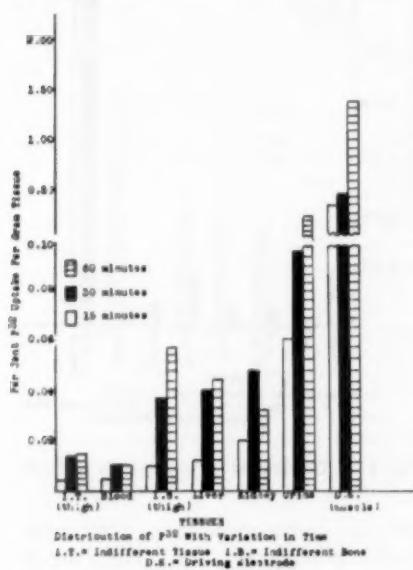


Fig. 5 — Distribution of P^{32} with variation in duration of current.

The longer the duration of current flow, the greater was the uptake by comparison. Since Faraday's Law is a function of time as well as current strength, varying the time of iontophoresis would also change the quantity of electricity which passes through a system.

Electrode Size

Variation in electrode size of the driving electrode did not appear to influence the uptake of radioactive phosphorus by various tissues after iontophoresis (fig. 6). Abramson, et al⁷ and Molitor²⁷ provide data in agreement with this statement. However, Abramson⁸ and Bredall¹⁶ indicate that greater amounts of drugs were introduced by larger size electrodes.

Concentration

Figure 7 demonstrates the increased uptake of radioactive phosphorus by the

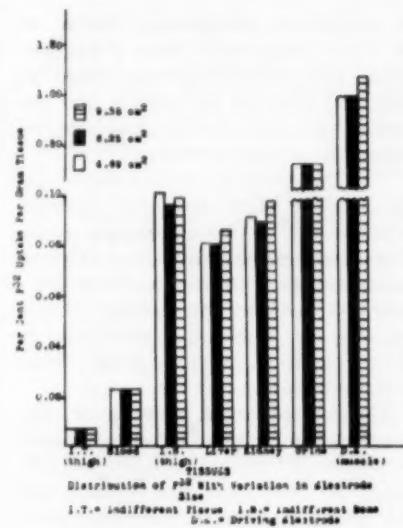


Fig. 6 — Distribution of P^{32} with variation in electrode size.

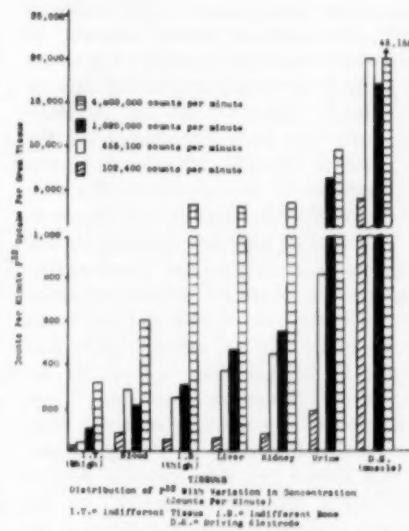


Fig. 7 — Distribution of P^{32} with variation in concentration.

various tissues after iontophoresis with an increase in concentration of P^{32} .

These experiments demonstrate that as the concentration of P^{32} was decreased, there was less overall turnover of this material in the various tissues, as far as counts per minute were concerned. It can be seen that, as one decreased the amount

of radioactive phosphorus, relative to the other ions present, there is less possibility that radio-phosphorus would be made available for penetration into the tissues. This type of result has been reported by several workers.^{5,6,8,11,16,20,23,27,30,32,35,56} No effect of concentration, or the opposite effect, has been reported by others.^{14,17,25,29} In a similar way, iontophoresis experiments with three different concentrations of strychnine sulfate demonstrated that the pharmacological response to strychnine was proportional to its concentration, using the lethal effects as the criterion.

The iontophoretic behavior of substances in simple solution was compared to colloids. I¹³¹ labeled albumin and colloidal Au¹⁹⁸ were used. It was found that the amount of these materials introduced into the animal by iontophoresis was considerably less than when non-colloidal materials were employed. Results after iontophoresis with colloidal Au¹⁹⁸ indicated a greater amount of radioactive material introduced into the local tissue in comparison to the amount introduced using I¹³¹ labeled albumin. However, the body distribution of the I¹³¹ labeled albumin after iontophoresis appeared to be the greater of the two. These results are illustrated in figure 8.

This finding may be explained on the basis that the colloidal Au¹⁹⁸ is of smaller particle size than I¹³¹ labeled albumin. The particle size of colloidal Au¹⁹⁸ was in the order of 0.005 micron, while that of the I¹³¹ labeled albumin is in the order of 0.0275 micron. In terms of mobilization of a particular material from the local living tissue by vital processes, it is a known fact that colloidal Au¹⁹⁸ is considered relatively immobile in this regard. Labeled albumin appears to be turned over by the vital processes in the tissues of the rat to a greater extent.

Summary

It was demonstrated that under the conditions of our experiments, using iontophoresis in the rat, the distribution of P³² in the tissues was proportional to the current density, duration of ionto-

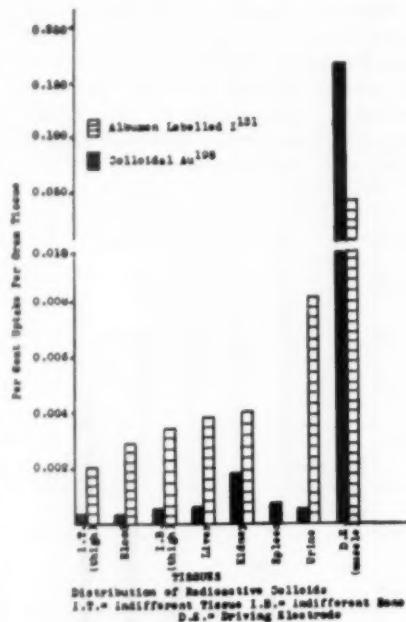


Fig. 8 — Distribution of radioactive colloids.

phoresis, and concentration of the radioactive phosphorus used. With strychnine sulfate, it was found that pharmacodynamic effects, convulsions and death, were also proportional to the concentration of strychnine used at the driving electrode site. It was found as the ionic strength of the solution used in iontophoresis with radioactive phosphorus was increased, there was a decrease in the radioactivity uptake by the tissues. The findings with colloidal Au¹⁹⁸ and albumin labeled with I¹³¹ indicate that these colloids are not readily transported into tissues by iontophoresis. Whether this was due to particle size or some other property common to colloids is not determined by these experiments. There appeared to be no significant effect of variations in pH and electrode size on the P³² distribution, in the animal, after iontophoresis, under the conditions of our experiments.

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Medical and Economic Factors Relating to the Compensable Back Injury

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Injuries to the back in industry constitute more than twelve per cent of all injuries incurred by people during employment hours. Few will deny that "back pain" is considered to be a serious problem. To understand why back pain has been singled out as a special problem, as opposed to all other industrial injuries, it is necessary to compare the medical and economic factors involved. The magnitude of the problem of industrial injuries, as a whole, can be appreciated by reviewing the figures available in New York State.

Approximately five million people fall within the jurisdiction of the New York State Workmen's Compensation Law. More than 700,000 industrial injuries occur every year. About 30 million dollars is paid for medical services and the direct cost to New York industry and business is approximately 200 million dollars annually. The indirect costs to industry and business as well as the economic loss to workers and their families are several times this figure. Analysis of cases closed in 1949 and 1950, by the New York State Workmen's Compensation Board, reveals the significance of back pain in the overall picture (fig. 1). In this analysis, the 26,541 cases closed refer to patients who suffered back pain as a result of alleged injury on the job. These patients revealed no X-ray evidence of trauma to the bones or joints. Six hundred cases of injuries to lumbar vertebrae are compared to the larger

group to demonstrate that these injuries differ in every aspect from the *Low Back Pain* group.

Injuries to all other parts of the body, including fractures of long bones, crush-injuries, amputations, head and neck, eye, face and nerve injuries, resulted in an average loss of 34.9 weeks of work as compared with 46 weeks average loss due to back pain. It is interesting to note that back pain, representing 12.4% of all injuries, was responsible for the loss of 16.1% of working time. More interesting, however, is the fact that permanent residuals are twelve times more frequent (36%) in general, than they are in back pain (3%). The cost of compensation for the general group is slightly higher than that of the back pain group, in spite of the reverse relationship of time lost. It is surprising that the percentage of totally and permanently disabled in each group is the same.

The interpretation of these relationships depends upon understanding certain basic factors relating to compensable injuries. They are validity of the history; criteria in estimating disability; effectiveness of treatment, and psychosocial-vocational elements.

Validity of the History

Claim to the benefits provided under the compensation laws is contingent upon

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	Number of Cases	Weeks Lost	Compensation Paid		Permanent Partial Disability	%	Permanent Total Disability	%
			Average	\$				
Injuries to all parts of body	218,863	7,431,183	34.9	146,983,699	854	77,548	36	.619
Injuries to back exclusive of bony injuries	38,941	1,215,710	46	31,578,994	814	783	3	.72
Injuries to lumbar vertebrae — exclusive of cord or nerve injuries	600	139,568	232	2,318,968	3822	102	17	1.66

Fig. 1 — Compensation cases closed in 1949 and 1950. (From figures established by New York State Workmen's Compensation Board, Research and Statistics Office. Courtesy of Dr. Willis M. Weeden, Medical Director).

on causal relationship between injury on the job and the symptoms. An employee may seek medical treatment for back pain because he "pulled on a rope," "lifted a package," "slipped on a doorstep," or "twisted the back" in the course of his work. Whether or not these reasons constitute competent causes for producing the symptoms is questionable. In many instances these were the last acts occurring at such time as these individuals felt that they could no longer carry on with their work. It has often been possible to obtain a confidential admission that back pain had been present off and on for years, "but just as I lifted the last bundle my back gave out." Such cases do not properly belong under the heading of accidents, but more important, the history is often misleading to the physician who seeks some history consistent with and accountable for the physical findings. Back pain resulting from the violence of an accident requires a different interpretation from the pain which gradually develops in a worker whose back does not hold up on the job.

Criteria in Estimating Disability

Back pain, as a symptom, is impossible to evaluate in terms of severity. The adjectives used and the descriptive phrases vary widely. What may be "killing" one man, may be "very uncomfortable" to another. The symptom, then, has generally been disregarded as

a measure of disability. One man stated that he could no longer live with pain which had been constant for three years, but his work history failed to reveal a single day's work lost during that period. More frequently, the story is that of inability to work because of pain which is not present when idle. Too often the physical examination can only be incompletely carried out because of the pain, or if completed, is not interpreted in terms of positive signs. In such situations, different examiners may have opposite points of view with regard to the degree of disability. Wide variations exist in assessing work capacity, depending upon the purpose of the examination. The family physician may consider his patient totally disabled while the insurance examiner discovers considerable capacity for work. The doctor who has in mind the patient's ability to meet the physical demands of his regular job, usually differs in opinion from the one who is interested in determining that the patient can do some kind of work. In most cases however, the final judgment is made by legal methods, and often by non-medical referees, as a mean estimate of the voluminous medical opinions which, in the long-standing cases, are little short of confusing.

Effectiveness of Treatment

Motivation for recovery cannot be underestimated as a major factor in the course of injury or disease. It plays an

important part in the anticipated results from treatment. With proper diagnosis and appropriate treatment the physician, as a rule, has reasonably good control over his patients. For various reasons this control does not appear to be as reliable over those with industrial injuries, as it is in the course of non-compensable injuries. In a four-year follow-up study of back cases in the United States Public Health Service Hospital at Stapleton, Staten Island,¹ the results of treatment of merchant seamen were 250% better than those obtained for federal compensation cases. This discrepancy in the response to treatment and the increased residual disability in compensation cases is widely known among those treating back injuries. A direct cause of this phenomenon is the fact that frequent consultation and changing of doctors is more prevalent in compensation cases, leading to confusion of the patient by the variations in opinion. It has, therefore, become necessary to know more about the patient than what can be derived from the history and physical examination in order to control every aspect of the "case problem," rather than the back pain alone.

Psycho-Social-Vocational Elements

The clues to many of the perplexing problems arising out of industrial accidents and back pain in particular are found in this sphere. The reason that so many acute back cases become chronic is often unrelated to the mechanism and extent of the physical injury. "The system of putting a monetary value on injury to the back creates a working basis between the physician, attorneys, insurance companies, compensation agencies, and the whole economic structure, which is as complex to the psyche of the individual as it is to the physician. Although monetary values pervade medical thinking, there is a strong tendency to incriminate this relationship in many forms of invalidism. There is no question but such is the case in many instances of psychological invalidism. However, one must be aware

of the number of cases in which the pre-morbid earning capacity was far in excess of the financial remuneration from compensation payments. As such, the gain cannot be purely financial and one must seek for it elsewhere."² Without a thorough investigation of the psychological factors, interpersonal and family relationships of the injured worker, a large number of cases of chronic back pain will derive little benefit from physical treatment. Psychological and psychiatric supportive therapy frequently play the major role in re-establishing employability. Hostility between husband and wife, or against an insurance company, doctor or employer, has frequently been identified as responsible for prolonged chronicity in injuries which, from a physical standpoint, should have subsided within a reasonably short time.

Employability does not necessarily follow a physical examination within normal limits. The number of cases in figure 1, under partial disability, demonstrates those declared physically competent to do some work. From practical experience, however, it is obvious that more than three per cent of all back injuries present employability problems. The superimposed psychogenic elements are very common, but these, unfortunately, are not always recognized or given due concern. Effective early treatment is the best weapon against the development of such psychogenic complications of back pain.

A corollary problem contributing to loss of earnings is the reluctance of employers to hire individuals who have suffered back injuries, even though they may meet physical requirements. This is an unjustified protective policy based upon past experience with the problem of back pain in general.

Having discussed back pain from numerous aspects, there remains the important question to answer: What can be done about it? Aside from preventive and screening procedures, the medical profession can do much. Improved methods of examination and interpretation of the mechanism and extent of

injury must be widely practiced if better results are to be expected. There is little uniformity in diagnosis and treatment, except in centers where back pain is considered to be a special entity requiring special management. The most important function of the physician in this problem is to recognize as early as possible, the true nature of the injury and to treat it appropriately.

From the viewpoint of diagnosis, a long list of causes is currently employed. Many of these, like myositis, fibrositis, faciitis and arthritis are unrealistic for describing why a normal man may have back pain while attempting to lift something too heavy. It appears more logical to classify back pain from the functional standpoint: Stress and strain; fatigue; instabilities, and other causes. Such classification includes all possible causes, provides a ready means of placing the patient into the proper class and simplifies the formulation of a treatment program.

It is estimated that roughly sixty per cent of cases of back pain are caused by stress and strain; thirty per cent by fatigue; five per cent by instabilities, and five per cent by other causes. Combinations of these frequently occur.

Stress and Strain

The normal functioning back is considered to be one which is structurally stable and permits a full range of movement of the trunk. It is controlled by muscles of adequate strength, length and tone, working reciprocally. This includes the abdominal muscles which oppose the back muscles, as well as the hip muscles which stabilize the pelvis. Many people function quite well with somewhat less than this ideal situation, but they are more prone to stress and strain injuries than the normal.

Back muscles fail momentarily when they are required to resist a force greater than their tolerance. Then, having been overstretched, they become painful, sensitive and tight. This tightness over a period of a few hours follows through to spasm. Thereafter, the muscles fail to release tension and thereby restrict

movement, since they will not elongate with trunk flexion. This occurs most frequently low down over the sacrum at the lower insertions of the erector spinae, but the stretched portion of the muscle may be at any level. Depending upon the position at the instant of strain, it may occur on both sides or on one side, or even in one bundle of muscle fibers or at the musculo-tendinous junction. If the spasm is allowed to persist for a long time, the abdominal muscles lose strength because they are unable to contract and a condition of true muscle imbalance pertains. On examination, the stiff back, possibly with a list or functional scoliosis, and painful movements in all directions, is seen. The objective here is to relieve the sensitivity at the injury site (it may be ligament fascia, as well as muscle) to relieve the spasm and restore muscle balance. This is a method of interpretation and procedure rather than a detailed description of treatment. This objective can be attained in numerous ways. Back strapping may immobilize the muscles sufficiently to ease the strain at any one point and restrict movement. Complete bed rest may serve the same purpose. Injection of local anesthetics has sometimes been very effective in providing immediate relief of pain and spasm. For larger surface control, spraying with ethyl chloride can relax entire groups of muscles and relieve pain. The various forms of heat often relieve the spasm. The approach used is a matter of personal preference, but pain and spasm can be sufficiently relieved to allow the stretching of tight muscles. The majority of patients with acute stress and strain injuries can be made comfortable within a few days and functional within ten to fourteen days. About ten per cent are the problem cases who go on to chronic back pain and lose more time off the job. Some of these get well with longer periods of rest and physical therapy, but a few will become problem cases due either to superimposed psychogenic factors, or the presence of an underlying complication. An individual with non-symptomatic osteo-

arthritis may thus suffer his first of a series of recurring attacks. There are too many people with X-ray evidence of osteoarthritis of the spine, without back pain, to consider that this condition of itself is painful. These individuals, like those with normal spines, suffer from stress and strain injuries in the same way. It may perhaps require less force to produce symptoms, but the mechanism and the treatment is the same. If symptoms are prolonged, as they may be, some modification of work habits limiting exposure to risk of strain and protective restriction of trunk movements by corsets or belts, may be required. These are individual problems.

When pain from an injury produced by stress and strain has subsided, a careful examination of the balancing musculature of the trunk must be made. Any isolated or gross weakness must be corrected by specific strengthening exercises to the weakened muscles. This is the most important part of the treatment. Kraus has made a major contribution to the method of examining, quantitatively, the strength and holding power of the muscles of the trunk and pelvis.⁵ Without reestablishing adequate strength and balance, recurrence of back pain with trivial stress can occur. Residual muscular weakness without correction is the most common cause of repeated attacks of pain.

Fatigue

It is from this classification that the most troublesome cases of back pain originate. "Fatigue," in the sense that it is implied here, does not refer to muscular exhaustion from overwork. It is the state of muscular inadequacy associated with prolonged tension without relaxation. This is apparently due to the accumulated metabolites of persistent muscular contraction and diminished tidal volume of blood in the tense muscles. When one carries a heavy suitcase it appears to become heavier and heavier until it requires to be set down to relax the arm muscles momentarily. It then may be carried again until the fatigue is repeated. Muscles recover

rapidly with short and frequent periods of relaxation. This differs from stress and strain in that the force resulting in fatigue is not greater than the ability of the muscles to resist. Fatigue develops insidiously and has a tendency to remain chronic for years. It is accompanied by pain due to sensitivity of muscles and fascia. It is in these cases that fibrositis and myositis are often found. Tenderness and trigger points are commonly located. Eventually, a low grade, persistent muscle spasm, or increased tension, develops. The prominent cause of fatigue is faulty posture. This may be developmental, habitual, occupational or secondary to pelvic obliquity, discrepancies in the leg lengths or as a compensation for shoulder girdle asymmetry. Good posture provides an economy of muscular effort expenditure by beginning activities from the relaxed position. Returning to the relaxed position without muscular effort ensures a high degree of efficiency. When the center of gravity does not fall within the axial plane of structural support, voluntary or involuntary muscular contraction is necessary to preserve balance. This is what happens when round, drooping shoulders with an exaggeration of the dorsal kyphosis is present. The back muscles are constantly under excessive tension in order to hold the trunk erect. Eventually an increase in lumbar lordosis occurs. This causes the long, straight lumbar muscles to develop fatigue, because of increased tension and lack of opportunity to relax. Many people work in positions preventing relaxation of the back muscles.

Once fatigue develops, it takes very little additional force to irritate the sensitive tissues with resultant backache. Recurring attacks of pain are the rule. These attacks are not acute unless true strain is superimposed on the fatigue. It is then obvious that the induration and myositis are secondary to the fatigue and not the underlying cause for the back pain.

Another cause of the fatigue syndrome is isolated muscular weakness. This may be observed after bed rest due

to illness. Return to work after convalescence can only be successful if the weakened muscles are brought up to normal strength. People who change from sedentary to heavy work must condition themselves before undertaking such change. With few exceptions, there are no jobs which are more likely to cause back pain than others. It is not the kind of work which leads to back pain; it is one's fitness for the performance of the work which is, in the end, the real factor. Working, sitting and sleeping positions are, therefore, extremely important in the lives of all of us in the prevention of fatigue, regardless of the work performed. There is no standard, correct posture. Each individual, at work, rest, or play and while standing or walking, should assume the most comfortable position. This applies even in the presence of gross postural defects. Periodically, he must also correct the defects with appropriate exercises and allow the muscles to relax at intervals. Persistent voluntary muscular efforts to hold "normal" posture can lead to fatigue in adults. Those who work in cramped positions should take time out frequently for short periods to change position, stand erect and then relax. They will be much more efficient at their jobs if they do.

Due appreciation of fatigue as a pain mechanism is essential for understanding the patient with back pain. The evaluation of a valid history and detailed examination of the back with fatigue symptoms requires considerable skill by the physician. Recognition of minor postural deficits, analysis of the dynamics of the spine, testing and palpation of the muscles and detection of tension and induration, as well as tender and trigger points, are part of the routine procedure.

Treatment Objectives

Treatment of these patients is along the line of specific indications. The objectives of treatment are:

- a) Correction of posture if possible. This may require corsets, braces, shoe lifts, abdominal supports or other mechanical means.
- b) Relieve pain, tenderness and trigger point tenderness, thereby breaking up reflex phenomena.

This may require physical therapy, infiltration of local anesthetics, bed rest, or all of these measures.

- c) Release and relax tense muscles. Accomplishment of these objectives requires time and patience and work. The various forms of heat, massage, passive stretching, active exercises for stretching, strengthening therapeutic exercises for the weak or opposing muscles, local anesthetics, surface anesthesia, resistive exercises and many other procedures provide a wide choice. Combinations of several are usually employed.
- d) Provide occupational therapy under supervised conditions to preserve or develop work tolerance and work capacity as physical improvement allows.
- e) Detailed instruction regarding posture habits and training for other work if necessary.

These constitute the bulk of the cases of chronic back pain. The results from a well-conceived plan of treatment are usually good, but the rewarding results are possible only with the full cooperation of the patient. It may take many weeks or months to bring about the desired satisfactory result. Without this intensive effort over the necessary time, many patients will remain disabled for years. Such approach is far superior to the treatment usually prescribed, namely diathermy two or three times a week. Such inadequate treatment contributes seriously to the general problem of back pain and deprives many patients of recovery. It is this group of patients who face frustration because of pain which is not relieved by the treatment received. Such frustration is intimately related to the complex psychological confusion which motivates their behavior.

Instabilities

This is a group of patients with protruded intervertebral discs, severe congenital anomalies which have become symptomatic, deformities of the spine, and other conditions which must be treated on an individual basis. These must be ruled out of the back pain cases as defined in this study. These patients however, may have developed symptoms due to fatigue or strain and must be recognized by thorough investigation. In the course of treatment, the same effort at obtaining adequate function by proper therapeutic exercises and maintenance of balanced strength must be made. This is in addition to any indicated definitive treatment. The poor muscular status and stiff, tight backs

frequently seen following immobilization in plaster jackets and after surgery, can be prevented. Successful surgery of the back is ultimately appreciated in terms of function rather than by X-ray findings.

Other Causes

Numerous other causes of back pain are to be ruled out but treated specifically. These include the early cases of symptomatic rheumatoid arthritis, advanced osteoarthritis, tumors, gynecological conditions, intra-abdominal causes, inflammatory diseases and others. They all begin with back pain and may simulate other types of cases until diagnosed.

Among those cases caused by the fatigue syndrome and instabilities, there is a high percentage with serious emotional overlay. This is the heart of the back pain problem. Because of the effects upon industry, society and business, these cases are true rehabilitation problems. They present a major physical disability, loss of earning capacity, disruption of family life, question of motivation and provocation of latent personality abnormalities. They place a strain upon private physicians, hospital facilities, insurance funds and compensation boards.

To meet this challenge, the Institute of Physical Medicine and Rehabilitation of the New York University-Bellevue Medical Center established a back consultation service. Its purpose is to evaluate these back cases, recommend treatment and plan a rehabilitation program in the same way it is done for those severely disabled from other causes.

The evaluation includes general, orthopedic, neurological, muscle and posture, psychological, and when indicated, psychiatric examinations, vocational advice and social service investigation. The patients passing through this service were referred by private physicians, insurance companies and the Workmen's Compensation Board. Most of these were chronic cases and all had failed to respond adequately to treatment. The duration of back pain varied from six months to twenty-five years, with an average of more than one year. Of these, 400 consecutive patients were

completely analyzed, disclosing:

- a) In the long-standing cases, although the non-compensable cases responded better to treatment, the general pattern was very similar to the compensation case.
- b) Fifteen per cent had one or more operations which, in general, were successful from a surgical viewpoint, but did not change the symptoms and often increased the psychological problems.
- c) At least eighty per cent presented such serious emotional and psychological obstructions to successful rehabilitation. It was obvious that physical treatment alone would be without value.
- d) Ten per cent required intensive psychotherapy before any other treatment could be considered. Cooperation for such therapy was difficult to obtain.
- e) Ten per cent were purely psychiatric problems which were considered nonfeasible even for psychotherapy at the stage seen.

Equally apparent were certain other features:

- a) Early treatment was often indifferent and inadequate and was considered the basis for the established chronicity.
- b) In cases employing surgery, most were discharged from the hospital without instructions and obtained no specific post-operative treatment.

The results of treatment on an intensive basis, applying the full resources of a rehabilitation center from the physical, psychological, social and vocational aspects, in spite of the complexity of these cases, have been gratifying. Without exception the non-compensable cases all preserved or regained significant functional capacity or returned to their former jobs. Of the compensation cases sixty per cent regained the capacity for employment but only three per cent returned to their former jobs. Management of these cases required intensive treatment from two to twelve months. During the two-year period of this study, a significant group of acute or recent cases of back pain were treated by the back team. These presented no problem in diagnosis, treatment response or re-employability by the methods of functional diagnosis and intensive specific treatment employed.

Summary

The compensable back injury is a special problem and differs from other industrial injuries in costs and time loss. Analyses of large groups of cases indicate that symptomatic treatment is inadequate, thereby allowing many to become chronic case problems. Early recognition of the functional diagnosis and treatment along specific, objective lines produces better end results. Treatment

principles rather than details are suggested. The long-standing chronic cases are true rehabilitation problems and require intensive teamwork therapy.

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A Comprehensive Program for Cerebral Palsy in a Community

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The responsibility of the community in the rehabilitation of its chronically ill and disabled citizens has become widely recognized and accepted during recent years, and the number and variety of services for handicapped persons have increased correspondingly. These services have been provided through many organizations, financially supported by various means including donations, grants from foundations, church funds, the Community Chest, and government allocations. Some organizations conduct annual fund-raising campaigns which are generously supported by the community. Funds obtained by this means are distributed so as to give additional opportunities to the handicapped.

This awakening of community responsibility is exemplified in the increased public interest in cerebral palsy. What was formerly regarded as a hopeless disease is now considered a condition which may be greatly helped by judicious therapy. The facilities for treatment of cerebral palsy have increased tremendously and are now available in many communities where, a few years ago, none existed. Credit for much of this progress must be given to two organizations: the National Society for Crippled Children and Adults, and the United Cerebral Palsy Association. Each has expended a great amount of time, effort, and money to help the estimated

550,000 persons having cerebral palsy in this country, of whom about 200,000 are less than 21 years of age. Each group has carried on an active and effective program of individual services, parent education, grants for research, scholarships to train personnel, and public information.

It is the purpose of this paper to describe the program for aiding cerebral palsy patients in Cleveland, a large metropolitan community, and to discuss certain phases of the development of this program. The authors believe that although all of the problems have not been solved in this community, important steps have been made toward comprehensive community planning. A general discussion of factors involved in planning a community program will not be presented in this paper but is available elsewhere.¹

Resources in Cleveland for Diagnosis, Treatment, and Care of Patients with Cerebral Palsy

In the summer of 1952 the Cleveland Health Council, the group responsible for determining policy in matters concerning community health, appointed a

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committee to study facilities and services in Cuyahoga County for the care and treatment of persons having cerebral palsy. The committee was formed because one of the organizations interested in cerebral palsy was considering the opening of a new facility for treating children. The committee consisted of representatives from thirteen organizations actively concerned with cerebral palsy. The Cleveland Health Council instructed the committee to determine the number of persons with this condition known to agencies within the community, and to list the services provided by these agencies.

To determine the number of cases of cerebral palsy in the community, the committee requested health and welfare agencies in Cuyahoga County to report all names in their records of persons having cerebral palsy. By September 8, 1952, the 24 agencies cooperating in this project had reported 1256 names; among which 708 "unduplicated" cases of cerebral palsy were found. Table I has been prepared from data obtained in the survey. A total of 543 cases of cerebral palsy was reported in persons less than 20 years of age, an incidence of 1.4 per 1000 population of this age group.* A comparison of the rates of incidence, 1.4 per 1000 white to 0.9 per 1000 Negro population under 20 years of age, supports findings reported by other investigators that cerebral palsy occurs more frequently in the white than in the Negro race. The results from the survey indicate that cerebral palsy may occur more frequently in males than in females, since this group contained 298 males and 245 females. Although it is believed that the data from this survey reflect accurately the incidence of cerebral palsy in Cleveland, it should be emphasized that this survey was not a census of all cases of cerebral palsy, but rather a listing of cases known to the cooperating agencies in this community.

*Incidence rates are based on population by age in April, 1950. The rates for age groups under 20 years of age would have been slightly lower if based on the population in 1952; increases in population were undoubtedly experienced in each of these age groups during the two-year period following the census.

Table I: Number of "unduplicated" cases of cerebral palsy per 1000 population

Age in Years	Cases	White		Negro	
		Population 1950	Rate	Population 1950	Rate
Under 5	122	123,932	1.0	8	16,533
5-9	174	93,166	1.9	17	11,887
10-14	110	69,533	1.6	9	10,248
15-19	93	64,978	1.4	10	9,836
Totals	543	351,609	1.4	44	48,354

* The 1950 population figures in table I are for non-white population; but since all except 1,963 non-white persons in Cuyahoga County are Negro, the use of non-white population figures will not affect the rates to any significant degree.

A comparison of the total number of reports made (1256) with the number of unduplicated cases of cerebral palsy (708) should not be interpreted as indicating duplication of services, since one agency may offer entirely different aid to the handicapped than does another. As a matter of fact, the committee was more concerned about those cases reported by only one agency than those reported by several, since it seemed likely that the former were not receiving the full benefit of services available within the community.

Committee Report

The committee's report to the Cleveland Health Council listed in detail the services for persons having cerebral palsy, offered by 33 agencies in Cuyahoga County. Using this report as a basis, the authors studied the major facilities in Cleveland and the services they provide for children and adults, respectively. The authors also assembled supplementary data such as sources of financial support, listing of available clinical services and testing procedures, and qualifications as to eligibility for service. In this study inpatient and outpatient facilities were regarded separately. It was possible, in this way, to obtain an accurate picture of services now available for persons with cerebral palsy in Greater Cleveland (September, 1954).

Three institutions in Cleveland provide integrated programs of clinical and diagnostic services for children with cerebral palsy: City Hospital, Cleveland Clinic, and University Hospitals. At the Cleveland Clinic, for example, an in-

Initial evaluation of each child consists of a complete physical examination by the pediatrician; consultations with the orthopedic surgeon, psychiatrist, and when indicated, with the ophthalmologist, otologist, neurologist, psychiatrist, dentist, and speech therapist; roentgenograms of the skull; laboratory studies (blood count, blood sugar, serology, urinalysis); electroencephalography and when indicated, pneumoencephalography; and psychometric examination. In facilities other than the three mentioned, clinical services are supplied by specialists who make regular visits.

Programs in Effect

A coordinated program of physical, occupational, and speech therapies is carried out by (1) The East Side and West Side Centers conducted by the Society for Crippled Children of Cuyahoga County; (2) the Cleveland Clinic and the United Cerebral Palsy Association of Cuyahoga County; (3) Rose-Mary Home for Crippled Children (capacity, 50 children); and (4) Cerebral Palsy Foundation School (capacity, 16 children). A home program in occupational therapy crafts is administered to handicapped children by trained volunteer workers; this service is sponsored by the Society for Crippled Children.

Other facilities contribute a variety of services. The Cleveland Hearing and Speech Center carries out special therapy for those children who have impaired hearing or defective speech; the Cleveland Guidance Center offers psychiatric assistance and guidance in management of children with behavior problems; the Council for the Retarded Child sponsors training classes for mentally retarded children with I.Q.'s below 50, of whom about 10 per cent also have cerebral palsy; and some hospitals in the community (for example, Mount Sinai, St. Luke's, and St. Vincent's Charity) provide certain types of therapy for a number of children with cerebral palsy.

Sunbeam School offers a graded scholastic program from kindergarten through ninth grade and also physical,

speech, and recreational therapies. Of the 264 children enrolled in the fall of 1953, 97 had cerebral palsy. Rose-Mary Home presents a graded educational program through the sixth grade for its inpatients of whom about 80 per cent have cerebral palsy. The United Cerebral Palsy Association of Cuyahoga County sponsors an academic readiness program at Murray Hill School for children, 6 to 11 years of age, whose I.Q.'s range from 50 to 70. These children are not eligible either for admission to Sunbeam School or for the special training classes conducted by the Council for the Retarded Child. During the summer, children with cerebral palsy may attend a summer camp provided by the Society for Crippled Children of Cuyahoga County at Camp Cheerful.

It is not possible in a study such as this, which surveys community facilities and services, to give proper emphasis and proportional credit to the various programs aiding persons having cerebral palsy. In particular, it is difficult to describe all phases of the valuable work that is being done by the two most active organizations: the Society for Crippled Children of Cuyahoga County and the Cuyahoga Chapter of United Cerebral Palsy Association. In a sense, the funds of these organizations have served both as catalysts and as primary reagents for the program for cerebral palsy in Cleveland. As catalysts, they have often returned much more in value of services than might be expected from the amount of funds expended. As primary reagents, they have been used generously and wisely to give financial assistance to parents of children with cerebral palsy, and thereby provide for important clinical services and therapy. As an outstanding example, the Society for Crippled Children of Cuyahoga County has pursued a most liberal policy in providing braces for children. Another important source of financial aid has been the Crippled Children's Services of the Cuyahoga County Welfare Department.

Adult Services

The program of services available to

adults with cerebral palsy is somewhat more limited than that available to children. Three institutions provide an integrated program of clinical and diagnostic services and therapy directed toward helping the handicapped individual attain maximum development namely the Cleveland Clinic, Highland View Cuyahoga County Hospital (inpatients only), and the Cleveland Rehabilitation Center (referred outpatients only). Attention to vocational problems is given by the Vocational Guidance Bureau, Cleveland Rehabilitation Center, and Highland View County Hospital. The United Cerebral Palsy Association of Cuyahoga County supports a program of adult rehabilitation as well as summer camping at Camp Cheerful (with the cooperation of the Cleveland Rehabilitation Center and the Society for Crippled Children of Cuyahoga County). Financial assistance is provided by United Cerebral Palsy Association of Cuyahoga County, by Cuyahoga County Welfare Department, and, if services will lead to employment in the near future, by the State Bureau of Vocational Rehabilitation. Other services to adults with cerebral palsy are offered by the Cleveland Hearing and Speech Center, Para-Progressives, an organization of adults with various disabilities who help each other to help themselves, Goodwill Industries' Sheltered Workshop, Cleveland Public Library with its homebound service, and community hospitals. Two institutions providing custodial care for adults with cerebral palsy are the County Nursing Home and Highland View County Hospital.

Unmet Needs in the Care and Treatment of Cerebral Palsy in Cleveland

In 1951, the Welfare Federation of Cleveland appointed a committee to conduct a survey and register all children under six years of age who were mentally and/or physically handicapped, and at that time, were in need of some service not available in Greater Cleveland. Fifty-five agencies participated in the survey, registering a total of 117 children known to them in the period from November 1,

1951, through April 30, 1952. Included were 46 children (table 2) with mental handicaps, 57 with both mental and physical handicaps, and only 14 with physical handicaps alone. Of the 117 children, 26 with combined handicaps and 4 with physical handicaps alone had been diagnosed as having cerebral palsy or closely related condition. Thus 25.6 per cent of the 117 children had cerebral palsy; consequently, the findings of this study and the conclusions of the committee are most significant and pertinent for our consideration.

Table 2: Cerebral palsied children registered in Greater Cleveland (1952) in survey of handicapped children under six years of age in need of some service not currently available

Handicap	Cases	Per Cent	Cases With C.P.*	Per Cent
Mental only	46	39.3	0	0
Mental and physical	57	48.7	26	22.2
Physical only	14	12.0	4	3.4
Totals	117	100.0	30	25.6

*These figures include all cases diagnosed as cerebral palsy, microcephaly, brain injury, "hypertonic," or congenital paraplegia.

A tabulation (prepared by the committee) of services needed by these children is shown in table 3. Unquestionably, the primary need for mentally and physically handicapped children in Cleveland is custodial care. Almost 40 per cent of the entire group lacked the basic requirements for a normal home:

Table 3: Need for service not currently available in Greater Cleveland (1952) as shown in survey of handicapped children under six years of age

Service Needed	Number of Children	Handicap		
		Mental	Physical	Physical
Custodial care in institutions	66	26	35	5
Preschool day training class for mentally retarded	24	15	9	—
Special foster home	10	3	6	1
Medical diagnosis and supervision	6	—	2	4
Preschool day training class for blind	3	—	2	1
Psychiatric placement	3	2	1	—
Preschool day training class for deaf and mental	2	—	2	—
Preschool day training class for nonspeaking	1	—	—	1
Preschool day training class	1	—	—	1
Outpatient physical therapy in West County area	1	—	—	1
Totals	117	46	57	14

namely, both parents; 15 per cent had been born out of wedlock, and 22 per cent had parents who were separated at the time of the survey. It is probable that in some instances, the presence of the handicapped child in the home was a factor in causing separation of the parents. In most of the families the mother had the responsibility of caring for one or more children in addition to the disabled child. This situation tended to result either in neglect of the handicapped child or in failure to give the needed love and attention to the other children. The committee pointed out that the provision of custodial care in an institution would not only lessen some of the disruptive tensions within the family, but also would assure the child's receiving specialized care and training and medical supervision.

An interesting conclusion made by the committee of the Welfare Federation was that, in view of the relatively small number of children having only a physical handicap who were found to require additional care, the needs of this group were being quite adequately met by present facilities in Cleveland. However, the committee believed that there had been a lag in planning to meet the needs both of the multiple handicapped child and the mentally retarded child less than six years of age. Although we are in general agreement with this statement, we do believe that certain important needs of children having cerebral palsy have not been fulfilled. In order of their importance, they are 1) provision of facilities for custodial care of children with cerebral palsy; 2) expansion of psychiatric guidance services for children with mental or emotional behavior problems; 3) establishment of a short-term, inpatient program (lasting several weeks to a few months), during which the child would undergo an intensive program of physical, occupational, and speech therapies, and the parents would be thoroughly instructed in a program of home therapy; 4) a preschool day training class for the mentally retarded child with cerebral palsy, which would aid in his adjustment with siblings and with other

children, and 5) special placement in foster homes so that, when necessary, the child may be observed and studied in different surroundings before final recommendations concerning further placement are made.

For older children and young adults, there is an important need for more realistic vocational guidance planning; this could best be carried out in the public schools. These handicapped persons should be given information that will prepare them more adequately to plan a vocation compatible with their abilities and disabilities. A second important unmet need for this group is a sheltered workshop program in which intensive training in activities could be offered, and which would lead to future employment.

Conclusions

An encouraging development in recent years has been the increase in public interest and financial support of programs to aid children and adults with cerebral palsy.

A comprehensive program for cerebral palsy is a planned program that has been formulated to avoid expensive duplication of effort and to assure provision of needed services with maximal benefit to all persons with cerebral palsy.

Cleveland has benefited from the active role that the Welfare Federation and its member agency, the Health Council, have taken in comprehensive planning for cerebral palsy. These agencies have admirably demonstrated a realistic approach to evaluation of the community's problem, its present facilities, and its needs.

A survey by the Cleveland Health Council of 24 community agencies which provide services to the persons with cerebral palsy revealed an incidence of 1.4 known cases per 1000 population less than 20 years of age.

Important unmet needs for children with cerebral palsy in Greater Cleveland include 1) custodial care; 2) increase in facilities for psychiatric guidance; 3) short-term program of inpatient care; 4)

preschool day training program for mentally retarded, and (5) increase in foster home placement service.

For youths and adults with cerebral palsy, there is an urgent need for more realistic vocational planning and for a sheltered workshop program.

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McGILL UNIVERSITY COMBINED DEGREE COURSE IN Physical and Occupational Therapy

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Introduction

After consideration for a period of five years, the Board of Governors of McGill University has authorized the establishment of a degree course in physical and occupational therapy. In order that this reorganized course provide an adequate supply of workers to fill available positions, it has been divided into three parts—B. Sc. degree in physical and occupational therapy; Diploma in physical therapy, and a Diploma in occupational therapy. To understand the syllabus as in effect at the present, demands of various authorities concerned must be considered. McGill University did not wish to establish a purely technical degree. It was felt that if a B. Sc. degree were to be granted, the students should take some cultural subjects in addition to their purely professional training so that this B. Sc. degree would be of the same standard as others. The cultural and scientific subjects had to be equivalent both in number and content to those normally required in any standard university degree.

Various licensing bodies throughout Canada demanded a specific number of hours of training in purely technical subjects which had to be fitted into the curriculum, and the Canadian Association of Physical and Occupational Therapists requested that we include suffi-

cient practical experience before permitting these students to be graduated. In addition, these groups had to be made cognizant of the fact that the medical profession did not wish to see us train "little doctors," who would consider their knowledge sufficient to practice medicine. The result of all these conflicting interests has actually been a compromise but it is one which probably will withstand the test of time. It has certainly proved popular with students now applying for entrance into the course. Since the work of physical and occupational therapists is based on science rather than on classics, the academic courses are of the scientific type. The student enrolls in the course with university qualifications. These qualifications are fairly well standardized throughout the country and it is suggested that the students should have taken mathematics during their preparatory years in high school.

Course Description

In the first year, the student is expected to follow the general B. Sc. course consisting of the following subjects: Mathematics, Physics, Chemistry, Botany, and Zoology. This course is of the standard university type.

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During the second year, the program includes Chemistry, Physiology, and Human Anatomy as the scientific subjects, while the technical subjects are sub-divided into Physical Therapy, Occupational Therapy, Electrotherapy, Psychiatry and elementary consideration of the disease processes likely to be seen by these therapists.

The third year comprises Bacteriology and Anatomy as the scientific subjects, with a continuation of Physical Therapy, Occupational Therapy, Electrotherapy and human diseases processes. During this year, hospital practice is introduced.

In the fourth year, the student studies

Table 1: Degree Course		
Subject	First Year	Hours
Mathematics (Lit. and Comp.)	Lect.	120
Mathematics (Trig., Alg., Analyt. Geo.)	Lect.	90
General Physics	Lect.	90
	Lab.	90
General Chemistry	Lect.	90
	Lab.	90
Biology (Gen. Bot., Zool. of Man)	Lect.	60
	Lab.	75
Second Year		
Organic Chemistry	Lect.	90
Elementary Physiology	Lect.	60
	Lab.	90
Human Anatomy (Skeleton and Upper-Lower Extrem.)	Lect.	90
	Lab.	60
Clinical Therapeutics	Lect.	30
Psychiatry	Lect.	30
Physical Therapy —		
Massage and Exercises	Lect.	90
	Lab.	180
Electrotherapy	Lect.	30
	Lab.	30
Occupational Therapy	Lect.	90
	Lab.	150
Hospital Practice	Lect.	112
Third Year		
Elementary Bacteriology	Lect.	90
	Lab.	60
Systematic Human Anatomy	Lect.	60
	Lab.	60
Clinical Therapeutics	Lect.	60
Physical Therapy	Lect.	60
	Pract.	94
Electrotherapy	Lect.	30
	Lab.	60
Occupational Therapy	Lect.	60
	Lab.	150
Hospital Practice	Lect.	112
Fourth Year		
Biochemistry	Lect.	60
	Lab.	90
Anatomy (Histology)	Lect.	54
	Lab.	168
Psychology	Lect.	90
Sociology	Lect.	60
Clinical Therapeutics	Lect.	90
Physical Therapy	Lect.	120
Occupational Therapy	Lect.	120
Hospital Practice	Lect.	480
Fifth Year		
Physiology	Lect.	90
	Lab.	90
Applied Anatomy	Lect.	90
Education	Lect.	90
Physical Therapy	Lect.	60
Occupational Therapy	Lect.	76
Hospital Practice	Lect.	500

Biochemistry, Anatomy (Histology), Psychology and Sociology as the scientific subjects and continues her work in Physical and Occupational Therapy. During this year the hospital practice is increased to 480 hours.

Added to the program in the final year is Academic Physiology, Anatomy and Education, as well as the professional work in Physical and Occupational Therapy. During this year, hospital work is again increased.

It is evident that the degree course (table 1) affords the student a standard B. Sc. Curriculum with continuation subjects in Anatomy and Physiology since the Biochemistry course is the same as the Physiological Chemistry course taught to medical students. At the same time, these students are given minor work in Sociology, Education and Bacteriology. The students who do not wish to be graduated with a degree follow the first two years of the course, and in their third year they decide either to take the diploma in Physical Therapy or Occupational Therapy (table 2). In the third year, they study scientific subjects as given degree students and concentrate on their specialty, studying the Physical Therapy or the Occupational Therapy course of the third and fourth years.

It should be considered when training women that most of them will marry at the age of twenty-five. To guarantee their availability to the medical profes-

Table 2: Diploma Course		
Subject	First and Second Year	Hours
Physical Therapy — same as degree course		
Third Year		
Elementary Bacteriology	Lect.	90
	Lab.	60
Systematic Human Anatomy	Lect.	60
	Lab.	60
Clinical Therapeutics	Lect.	60
Physical Therapy	Lect.	60
	Pract.	94
Electrotherapy	Lect.	30
	Lab.	60
Occupational Therapy	Lect.	120
Hospital Practice	Lect.	112
First and Second Year		
Occupational Therapy — same as degree course		
Third Year		
Elementary Bacteriology	Lect.	90
	Lab.	60
Systematic Human Anatomy	Lect.	60
	Lab.	60
Clinical Therapeutics	Lect.	60
Physical Therapy	Lect.	60
	Pract.	94
Fourth Year P.T.	Lect.	120
Electrotherapy	Lect.	30
	Lab.	60
Hospital Practice	Lect.	112
First and Second Year		
Occupational Therapy — same as degree course		
Third Year		
Elementary Bacteriology	Lect.	90
	Lab.	60
Systematic Human Anatomy	Lect.	60
	Lab.	60
Clinical Therapeutics	Lect.	60
Occupational Therapy	Lect.	60
Hospital Practice	Lect.	150
Fourth Year O.T.		
Hospital Practice	Lect.	120
	Lab.	112

sion for any length of time, they should be graduated when they are nineteen or twenty years old.

With the diploma course, students not interested in a degree are able to be graduated and start working. This provides us with a group of therapists satisfactorily trained, and who are available for longer periods as opposed to those who have spent more time in training. So far as the number of students is concerned, it is anticipated there will be about forty in each of the first three years and twenty in each of the two final years. We will then have available each year twenty diploma and twenty degree students.

Conclusion

This plan of study attempts to reverse the present trend to lengthen the training time for students. Training courses are of such duration that professions tend to educate themselves out of a job. This has already happened to the nurses and is in the process of happening to other paramedical groups. Short course

trained attendants are now doing the work that once was performed by nurses. Students who are graduated after a long training period congregate in large centers, where there is overcrowding, and will not shoulder the risks involved in starting out in a smaller community. Provided an adequate basic training is given, an intelligent person should be able to build upon it in any direction required in his daily practice.

Throughout the course, endeavors have been made to get away from the practice of block teaching which, while it concentrates on one subject at a time, does not provide a variety of material necessary for the students to absorb easily.

Practical work is carried on at the various hospital clinics associated with the university and sufficient clinical material is available in the Departments of Physical Medicine and Rehabilitation of these clinics to enable the student to see all types of cases.

For reprints, write Dr. Fisk, 592 Walpole Ave., Montreal, Que., Canada.

Prescription for the Long Leg Brace

Duane A. Schram, M.D.
Seattle

A prescription for the long leg brace should be as detailed and precise as would be any prescription for physical agents or drugs. Too often, through habit and availability, we have become satisfied with a standard type of brace and have prescribed it for many or all functional requirements and physiological residual patterns. Actually, the basic variations for overall long-leg prescription are not many and with persistence, one can usually persuade the local brace shop or orthotist to provide the desired type of brace in each case. In specifying the components of construction it is essential to consider the basic requisites for the prescription. A long leg brace frequently should provide more than mere support. It should be designed also to offer protection and/or mobilization as well.

Support

Unless there is some indication of need for a weight-bearing brace, such as the presence of bone disease or fracture, no attempt should be made toward body support. The weight of the trunk is carried on the leg and the brace supports the extremity. The brace should be fitted accurately, using the conventional three-point pressure method in which the upper thigh band and shoe are the distal fixed ends of two lever arms. The knee is the fulcrum of this system, and is the region in which the least pressure is necessary to extend the knee.

A typical long leg brace used in many areas is represented in figure 1. It has

Read at the Thirty-second Annual Session of the American Congress of Physical Medicine and Rehabilitation, Washington, D.C., September 8, 1954.
Chief, Physical Medicine and Rehabilitation, VA Hospital.

the usual calf band and one thigh band with leather cuff above the knee. The leather lacings anteriorly exert pressure above and below the fulcrum or knee. Since there is no mid-thigh band, control of extension (or flexion) of the knee is accomplished by aligning the leather molding on the uprights. Under the most favorable circumstances, the pressure area although apparently extensive, is inadequate for control. This large cuff is extremely difficult to adjust and usually results in an inaccurate fit. Also, in this type of brace the upper rigid fixed point or thigh band is usually far below the ischial-tuberosity, leaving a relatively short lever arm above the knee. Since two short lever arms attempt to extend the knee, the leg is seldom held in adequate extension. In fact, many patients using this type of brace frequently develop some degree of knee flexion contracture, which may be followed by a similar contracture of the hip with lordosis. This type of support obviously would encourage deformity and discourage function. In many cases, a poorly designed brace of this sort can be responsible for confining a bilaterally braced patient to a wheel chair who might have been ambulatory if a well-designed brace had been prescribed and adequately fitted.

Protection

In all cases a long leg brace will splint a lower extremity and will offer protection to some degree, especially if the leg is flail. Protection as a specific requisite may for example, involve the prevention of back-knee. In mild conditions the mid-thigh band sufficiently controls the amount of knee extension. In more severe cases of recurvatum, a leather extension may be added to the band or the calf band may be used to exert additional pressure below the knee. Stops at the ankle are usually considered functional units; especially a posterior stop that guides the foot so that it will adequately clear the floor. Actually an anterior, posterior or double stop could be prescribed for protection. Either would prevent excessive stretching of the respective neuromuscular units, and



Fig. 1 — Brace is constructed with a calf band and one thigh band posteriorly. The leather cuffs in front are above and below the knee.

thus offer a degree of protection. Knock-knee dowels are occasionally prescribed to correct deformity, although this hardly seems possible in a functional brace. However, a frequently adjusted dowel on the inner condyle should prevent deformity. Another common example of protection is the use of braces for positioning. In this case the extremities are rendered immobile in neutral position by splinting one brace to the other with a cross bar between the inner uprights.

Mobilization

Frequently mobilization procedures using long leg braces can supplement manual stretching or follow surgical release of resistant contractures. Apparatus alone may be sufficient to accomplish the desired result, especially if the contractures are not severe. In applying this method, one must be certain of the degree and resistivity of the deformity and have a thorough understanding of the mechanics involved. The traction should be gradually but never excessively increased. Usually the patient's tolerance is the guide to the amount of tension that should be exerted and the length of time the traction should be applied. One of the most common procedures for mobilizing a mild to moderate knee flexion contracture is to exert pressure over the knee with a padded strap in a locked brace. For more rigid contractures, turn-buckles or spring attachments on an extended outside upright above the knee have been used. For contracted heel cords various spring devices may be incorporated in the ankle hinge; or, coiled springs may be attached directly between the uprights and a foot plate. In children, moderately tight hip flexors can be mobilized by using the weight of two long leg braces splinted to each other by a crossbar. The pelvis in this case is firmly held by a well-fitting corset and a mobilizing force is exerted by gradually lowering the extremities into hyper-extension in either the supine or prone position.

Specifications of Prescription

After it has been definitely indicated

that a brace is required it is essential that the details of construction be considered. The basic units of construction of the long leg brace are frame; knee joint, and ankle joint.

Frame: The stability of a brace is incorporated in a frame consisting of uprights, a calf band, thigh bands and occasionally, a pelvic band. This framework should have adequate rigidity for the use required. Generally individuals who do hard work, children and severe spastic residual cases require a frame constructed of relatively heavy gauge material. In contrast, patients whose daily duties are relatively light, and flaccid neuromuscular residual cases may require much less emphasis on rigidity and greater concern for utility and appearance.

Although pelvic bands undoubtedly are prescribed more frequently than is necessary, an occasional case will benefit from this added attachment. For example, most spastic cases which are more than mildly involved may require this additional support to attain the upright position. Also, flaccid cases which are hyper-mobile in the hips, especially in children, may require added stability. In cases involving moderate to severely contracted external rotators, some physicians prescribe a pelvic band to hold the legs in alignment. If the patient has had inadequate early care and is unable to obtain the follow-up care necessary for adequate mobilization, this added structure may be required to hold the legs properly. It should be emphasized however that if too severe a twisting force or torque is exerted on the leg using the foot as a primary lever, a varus condition may develop.

Knee Joint: The first brace in figure 2 has a double lock at the knee; the other two braces have a single outside lock. The first brace has a box hinge arrangement while the second has reinforced aluminum milled hinges. The third brace combines a milled hinge and a lapped joint. Although the sliding pin lock on the last brace will usually suffice under moderate working stress, the ring lock undoubtedly is more adequate up

to and including severe stress. A simple spring extension on the ring rendering an automatic drop lock is probably the most adaptable and efficient lock. If a patient has rather prominent inner condyles, a relatively large hinge such as the box or mill type will be too bulky, causing the patient to walk with some degree of abduction. When such condyles are present, it is possible to fabricate a single lap joint on the inner uprights which will render less bulk and frequently permit the patient to walk with a more natural gait. The heavier type of hinge is retained on the outer upright. This is usually sufficient to keep the brace in adequate alignment, assuming the posterior bands are of sufficient gauge. In children a lap joint on both

the inner and outer uprights may be sufficient if the frame is constructed of hard metal, preferably stainless steel or its equivalent.

Ankle Joint: A well-fitting shoe with a firm shank is the foundation of a long leg brace and there are two types of shoe attachments which complete the bracing unit. Figure 3 shows two braces with stirrup hinges and one with a caliper attachment. The second and third braces have rigid anterior and posterior stops; the second has a caliper hinge and the third has a stirrup arrangement. The first brace is another stirrup with a posterior spring stop.

There seems to be considerable controversy in determining the most desirable type of ankle hinge. Actually, both

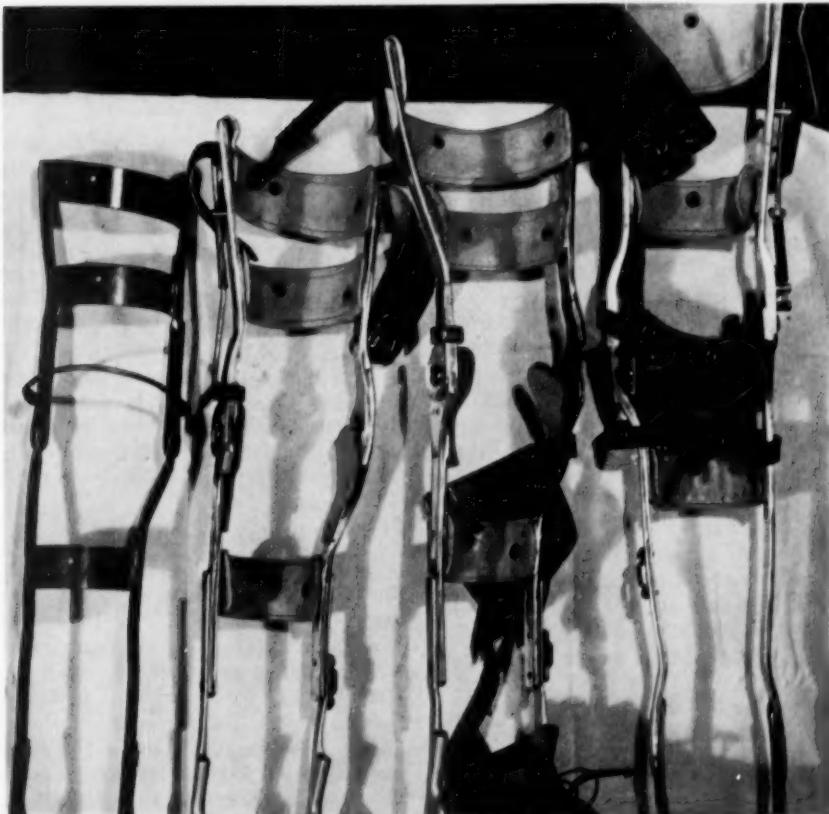


Fig. 2 — Reading from left to right, the first brace has a tubular frame with box joints at the knee. There is a lock on both hinges with a bail attachment. The second brace has milled joints and an outside spring ring lock. The third brace is constructed with an overlap joint on the inside and a milled joint on the outside using the conventional drop ring lock. The last brace has milled joints with an outside pin lock.

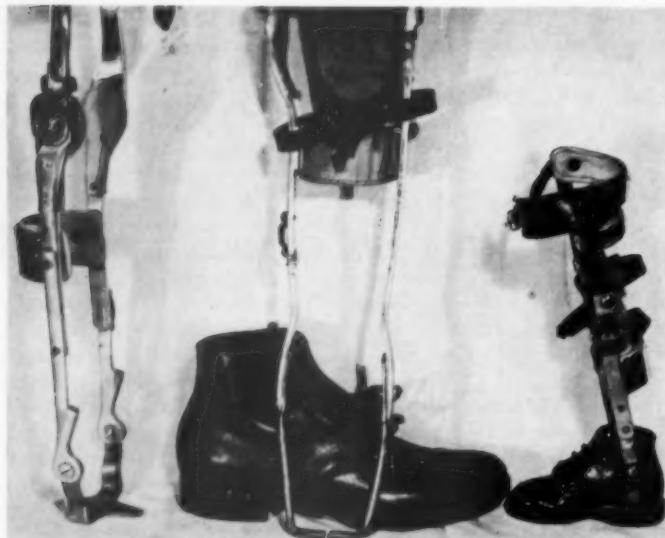


Fig. 3 — Reading from left to right, the first brace has a stirrup shoe attachment with a posterior spring stop. The second brace is caliper in type with anterior and posterior stops. The last brace is another stirrup with anterior and posterior stops.

units have their advantages and disadvantages. The stirrup is much sturdier than the caliper hinge but does not possess the utility and the preferred appearance of the latter. Consequently, the stirrup is preferred for children where rough use is anticipated and changing shoes is not a problem. Most children, due to wear or growth, require new shoes about every three to six months. The requirements are different in prescribing for most women, who prefer at least one change of shoes, and with whom ruggedness is of secondary importance.

Much has been said and written with respect to the advantages of the stirrup attachment, which are attributable to the fact that the hinge is nearer the physiological joint of the ankle. There is no doubt that the caliper type of hinge results in more movement of the leg in the brace but through experience it has been found that this, as a rule, is no particular problem. Actually the amount of movement, which is often described as excessive, is not significant under practical conditions. Should there be anterior posterior stops there obviously would be very limited shifting movement

in the brace. Occasionally, rigidity may be as important as utility, and a highly effective recent development to meet these requirements is a prefabricated shoe attachment having a caliper arrangement with the brace joint opposite the axis from the ankle joint. Regardless of the type of shoe attachment, it should be emphasized that its placement on the shoe should not be at a uniform angle for all cases, but should be determined by the degree of toe-out in the individual case. The amount of tibial torsion varies considerably in relation to age and involvement.

Conclusion

This presentation has outlined briefly the indications for and a detailed description of long leg brace prescriptions. It is essential that the available components of construction be specified to fulfill the basic requisite for prescription. It should also be emphasized that adequate bracing can only be accomplished by accurate fitting and followed up with frequent re-evaluation for repairs and adjustments.

REPORTS OF SECTIONAL MEETINGS

The following reports were presented at the annual business meeting of the American Congress of Physical Medicine and Rehabilitation, September 6-11, 1954, Hotel Statler, Washington, D. C.

Central Section

The Central Section of the American Congress of Physical Medicine and Rehabilitation met with the newly formed section on Physical Medicine and Rehabilitation of the Ohio Medical Association in Columbus, Ohio, April 15, 1954. Permission was secured from Dr. Wm. Benham Snow, President of the Congress, to hold this combined meeting with the Ohio section, to help this organization establish its first meeting. A program of six interesting scientific papers was presented. Dr. Frank H. Krusen of Rochester, Minnesota was the guest speaker and presented a paper on ultrasonics in medicine.

Respectfully submitted,
Ralph Worden, *Chairman*
Frederic B. House, *Secretary*

Rocky Mountain Section

The second annual meeting of the Rocky Mountain Section of the American Congress of Physical Medicine and Rehabilitation was held at the University of Colorado Medical Center on April 10, 1954.

After a short business meeting the following scientific papers were presented: James Stephens, M.D., "Causalgia and the Occurrence of Pain in Peripheral Nerve Injury," Keasley Welch, M.D., "Surgical Management of Injuries to Peripheral Nerves," and Fred Sheffield, M.D., "Physical Agents in Diagnosis and Treatment of Peripheral Nerve Injury."

In view of the fact that attendance was good, including a large number of non-physicians, we look forward to a continual expansion of the activities of the section.

Respectfully submitted,
Harold Dinken, *Chairman*
Jerome W. Gersten, *Secretary*

Eastern Section

The Eastern Section meeting was held in Newark, N.J., Saturday, April 10, 1954. The morning session consisting of a clinical demonstration, was supervised by Drs. Charles Brooke, Thomas Scanlan, and Brod Troedsson at the VA Hospital in East Orange, N.J. The afternoon session was held at the New Jersey Academy of Medicine. Papers on disabilities of the hip joint were presented by Drs. Henry Milch, John J. Flanagan, Arthur L. Watkins, and Allen S. Russek. Following

dinner, Dr. Louis B. Newman discussed the facilities of the VA Research Hospital in Chicago. Dr. A.B.C. Knudson presented the scientific film entitled "The Long Cane."

At the business meeting, the advisability of an autonomous organization for the Eastern Section was discussed. Boston was selected as the meeting place for 1955.

Respectfully submitted,
Hans J. Behrend, *Chairman*
Herman L. Rudolph, *Secretary*

Southern Section

The first annual meeting of the Southern Section of the American Congress of Physical Medicine and Rehabilitation was conducted at Brooke Army Hospital, Fort Sam Houston, Texas, on Friday and Saturday, February 26 and 27, 1954, under the auspices of the Physical Medicine Service. An invitation from the Commanding Generals of Brooke Army Medical Center and Brooke Army Hospital, Major Generals Shambora and Griffin, determined the locale for the meeting.

Letter invitations were sent to members of the Southern Section of the Congress and invitations were extended to sectional groups of the APTA, AOTA, and AMPR. Three scientific sessions were held; programs appeared in the Archives. Total attendance was 143 with 28 Congress members in attendance.

Dr. Oscar O. Selke, Jr., Houston, Texas, was the principal banquet speaker. A business meeting was held and preliminary plans for the second annual meeting were discussed. An invitation to hold the next meeting in Houston, Texas, was accepted by the section. A resolution to provide continuity of the section and its annual meetings was proposed and presented to the Congress.

Respectfully submitted,
John H. Kuitert, *Chairman*
Edward M. Krusen, Jr., *Secretary*

Southeastern Section

No official sectional meeting was held during the past year. Expression of interest in the further development of our section was received following the meeting of the Southern Medical Association in October, 1953. Since that time there has been no common geographical meeting ground.

The progress made in our section has been dependent on the individual. Several have

been active in developing the section on Physical Medicine and Rehabilitation of the Southern Medical Association; many have presented papers at various medical meetings, and a symposium on Rehabilitation was held at the Virginia Medical Society Meeting in October, 1953. Other similar notable activities were undertaken in this section.

The following recommendations were made to the general membership and the incoming chairman:

The Southeastern Section should hold an annual session at the Southern Medical Asso-

ciation meeting. It is suggested that this be a joint meeting with the Southern section.

Area leaders should be designated for various focal points in the Southeastern section. It is suggested that definite projects be undertaken in each area. These projects should be designed to stimulate interest in this special field of medicine and should be adapted to meet the needs peculiar to that medical community.

Respectfully submitted,
Herbert W. Park, Chairman
Louis Britt, Secretary

MEDICAL NEWS

Members are invited to send to this office items of news of general interest, for example, those relating to society activities, new hospitals, education, etc. Programs should be received at least six weeks before the date of meeting.

Buffalo University to Establish An Artificial Limb Fitters College

The University of Buffalo is planning to establish the first school in the country for training limb fitters and brace fitters, it was revealed by Joseph E. Traub, Chief of the Prosthetic and Orthopedic Department of the university's School of Medicine, in an address to the Industrial Medical Association.

"Until this time, all limb and brace fitters have been trained by the apprenticeship method, with no two apprentices undergoing the same training," Mr. Traub explained. "Therefore, there has always been a great difference in the quality of fitters. The proposed school will have a four-year curriculum and offer a Bachelor of Science degree. The establishment of this school is a very difficult task and it needs all the support it can get."

Mr. Traub stated that the Department of Physical Medicine and the Chronic Disease Research Institute at the University of Buffalo School of Medicine is already unique in this program because it is using as subjects those age groups and amputee types "which have been considered unfit by other research units — the old, the very young, and those with multiple disabilities."

Information Not Withheld by AEC

The Atomic Energy Commission stated that medical and biological information developed

by its scientists on the effects of nuclear radiation, blast, flash burns and fallout is made public as rapidly as it can be properly evaluated and correlated.

The Commission denied that the medical profession is refused access to the results of its studies of the effects of nuclear explosions on human beings and animals and methods for treating casualties.

The only biomedical data which remains classified is in piecemeal or incomplete form and therefore inadequate for use by the medical profession. As soon as such information is brought into comprehensive and helpful form, it is published in line with the Commission's established policy.

AMA Creates Geriatrics Unit

At the clinical session in Miami, last December, the AMA House of Delegates passed a resolution calling for the creation of an organization on geriatrics within the structure of the Association.

The new unit will develop and assist committees on geriatrics and gerontology in state and county societies and act as a liaison between these committees to insure a free flow of information "between all levels of organized medicine on the subject of geriatrics."

The resolution also named as purposes of the unit: "To make available to the American people such facts, data and opinions concern-

ing the subject of geriatrics as may be considered of value in alleviating social and medical problems created by the increasing population of older age groups; and to perform such other duties as will improve and advance the medical care rendered to people of the older age group."

Tenth Annual Schering Award Competition Opens for Nation's Medical Students

The tenth annual Schering Award competition for medical students has opened, it was announced by Robert W. Burlew, M.D., chairman of the award committee. Its aim is to encourage medical writing and exploration of current research literature.

Titles of three subjects on which American and Canadian students are invited to submit papers this year are: Current Concepts in the Management of Osteoporosis; Prevention and Treatment of Blood Transfusion Reactions; and Recent Trends in the Clinical Use of Adrenocortical Steroids.

Both a \$500 first prize and second prize of \$250 will be awarded for each of the three subjects. Outstanding authorities in each field will select the winners. Special recognition in the form of a professional gift will be given each student submitting a meritorious paper.

Deadline for entry forms specifying the choice of title is July 1st. Manuscripts should be mailed not later than October 1st. Students may compete individually or cooperatively in teams.

Information and instructions for the award competition are available from the Schering Award Committee, 60 Orange Street, Bloomfield, N. J.

CP Group to Meet

The annual meeting of the American Academy for Cerebral Palsy is scheduled for Oct. 10-12, 1955, Memphis, Tenn. The meetings are open to members of the medical and allied professions who are interested in cerebral palsy. The three-day program will include instructional courses in the various phases of cerebral palsy as well as a formal program. Those wishing to attend may obtain an invitation from Robert A. Knight, M.D., Secretary-Treasurer, 869 Madison Ave., Memphis 3. Hotel reservations are to be made directly with Mr. Scott Stewart, Manager, Claridge Hotel. Dr. Lenox D. Baker, Duke Hospital, Durham, N.C., is president of the organization.

Conference on Aging

The University of Michigan Eighth Annual Conference on Aging will be held in Ann Arbor, Mich., on June 27-30, 1955.

Topic of the conference is Aging — Applying Today's Knowledge Today. The program will be focused on gaining greater skill in the use of principles, practices, methods and

technics needed for more effective service to older people. Work-shop enrollments will be limited in order to keep groups small. Pre-registration is, therefore, urged. For further information write Wilma Donahue, Division of Gerontology, 1510 Rackham Building, Ann Arbor, Mich.

UN Brochure Issued in French, Spanish

"Services for the Physically Handicapped," published by the United Nations, will be available to an increased audience with its publication in French and Spanish.

The brochure, which was prepared for the UN by the International Society for the Welfare of Cripples, has been one of the most popular United Nations publications and thousands of copies have been sold in the English version. Its contents include an analysis of the problems of disability, a summary of rehabilitation services, suggestions for the development of programs to assist the handicapped, and an explanation of various types of available technical assistance.

Interested persons may secure copies of the brochure from the Sales and Circulation Section, United Nations, New York, U.S.A.; from the Sales Section, United Nations Office, Palais des Nations, Geneva, Switzerland; or from sales agents in the various countries.

The American Institute of Dental Medicine

The next Annual Meeting of the Institute will take place at the Desert Inn, Palm Springs, Calif., October 23-27, 1955. Applications and full information may be secured from the Executive Secretary, Miss Marion G. Lewis, 2240 Channing Way, Berkeley 4, Calif.

Prescription for Medical Partnerships

"Prescription for Medical Partnerships," a general information booklet on the business details of establishing and continuing a group medical practice, has been prepared by Dr. Charles Maertz, retired medical director of The Union Central Life Insurance Company. A copy can be obtained by writing to "Medical Partnerships," Field Service Division, P. O. Box 179, Cincinnati 1, Ohio.

Rehabilitation Monograph VIII

The Institute of Physical Medicine and Rehabilitation, of New York University-Bellevue Medical Center, has announced the publication of Rehabilitation Monograph VIII, "A Manual For Training The Disabled Homemaker," by Howard A. Rusk, M.D., et al.

This manual is the first attempt to compile under one cover some of the simple but important technics by which homemakers with physical limitations may carry out their household tasks.

The manual consists of 167 pages with 107 illustrations. Copies are available at the Institute of Physical Medicine and Rehabilitation, 400 East 34th Street, New York 16, N. Y. The cost of the manual is \$2.00.

Grant Made to Psychiatric Institute

The Office of Vocational Rehabilitation, Department of Health, Education, and Welfare has announced that OVR, on recommendation of the National Advisory Council on Vocational Rehabilitation, has approved a grant of \$27,800 to the New York State Psychiatric Institute for establishing a mental hygiene clinic for deaf adolescents and adults. The Institute will operate in three important mental health areas for deaf people — research, service, and training of others to serve as mental hygiene workers for the deaf.

New Job Placement Service For Industrially Injured

A specialized placement service for compensation claimants has been added to the rehabilitation activities for the industrially injured at the Institute for the Crippled and Disabled, 400 First Avenue, New York City. The new service provides carriers and claimants with specialized job placement either as part of a comprehensive rehabilitation program or as a separate service.

Scholarship Grants

Physical therapists are being recruited in Alabama through scholarships established by the Alabama Society for Crippled Children.

Three grants, each worth \$1,200, are available to men and women who have three or four years of college background in the biological, physical or social sciences, or in physical education or nursing.

Information about the grants is available from W. H. Harrison, Executive Secretary, Alabama Society for Crippled Children and Adults, 472 S. Lawrence St., Montgomery, Ala.

New Medical Publication

A quarterly intended for interns and residents is being launched by Mead Johnson and Company. The title is "Mead Digest." The publishers plan to slant this publication directly at the practical problems of getting started in practice as they present themselves to the young doctor finishing his hospital training period.

To Live Anew

Dr. Daniel L. Seckinger, Director of Public Health of the District of Columbia, announced the presentation of a thirteen-week television series of vital importance to all Americans. This series entitled "To Live Anew," began Sunday, March 20, 1955.

"To Live Anew" will show what happens to people who have strokes, heart attacks, loss of limbs, broken bones, infectious diseases as polio, muscular dystrophy or multiple sclerosis, cerebral palsy, trauma, circulation difficulties and arthritis. It will also show how these same people are restored to full citizenship — to useful lives in their homes and productive lives in the community.

Dr. Josephine J. Buchanan, Chief, Physical Medicine and Rehabilitation Department, District of Columbia General Hospital, is the Medical Consultant for the series.

Technical Bulletin Available

A completely revised, comprehensive bibliography of the literature on G-11® (Hexachlorophene) has just been published by Sindar Corporation of New York. This bibliography, Technical Bulletin H-1, dated March 1955, contains references and abstracts of some 136 scientific and trade articles, and abstracts of 19 patents, both foreign and domestic.

The index of the Technical Bulletin has been changed so that abstracts on any subject can be easily located. The index is divided into eight broad categories including Biological Properties, Compatibility Medical Applications, Patents, Physical and Chemical Properties, Product Uses, Test Methods and Toxicological Properties. These individual categories are further sub-divided giving the reader easy access to any particular subject of interest.

Books Received

Books received are acknowledged in this column as full return for the courtesy of the senders. Reviews will be published in future issues of the journal. Books listed are not available for lending.

Psychiatry and Common Sense by C. S. Bluemel: The Macmillan Co., New York City.

Medicine in Its Human Setting by A. E. Clark-Kennedy; Faber & Faber Ltd., London.

Amputations by Leon Gillis; Grune & Stratton, Inc., New York City.

Two Legs to Stand On by John D. McKee; Appleton-Century-Crofts, Inc., New York City.

Basic Anatomy by G.A.G. Mitchell, and E. L. Patterson; The Williams & Wilkins Co., Baltimore.

Smoking and Cancer — A Doctor's Report by Alton Ochsner; Julian Messner, Inc., New York City.

Science the Super Sleuth by Lynn Poole; McGraw-Hill Book Co., New York City.

Surgery of the Elbow by Frederick M. Smith; Charles C Thomas, Springfield, Ill.

Peripheral Nerve Injuries edited by H. J. Seddon; Her Majesty's Stationery Office,

London.

Peripheral Vascular Disease by E. V. Allen, et al; W. B. Saunders Co., Philadelphia.

Der Ultraschall in Biologie und Medizin by Walter Beier, and Erick Dorner; Georg Thieme Verlag, Leipzig, Germany.

Kinderorthopädie by Rupprecht Bernbeck; Georg Thieme Verlag, Leipzig, Germany.

Fractures in Children by Walter P. Blount; The Williams & Wilkins Co., Baltimore.

My Left Foot by Christy Brown; Simon and Schuster, Rockefeller Center, N.Y.

Individualisation En Education Physique by Paul Frankard, and D. Walckiers; E. Nauwelaerts, Louvain, Belgium.

The Medical Care of the Aged and Chronically Ill by Freddy Homburger; Little, Brown & Co., Boston.

Über Die Vitale Tendenz Zu Reaktiven Überleistungen by Gerhardt Katsch; Akademie-Verlag, Berlin.

X-Ray Atlas and Manual of Esophagus, Stomach and Duodenum by T. J. J. H. Meuwissen; The Elsevier Press, Houston.

Funktionelle Atmungstherapie by Julius Parow; Georg Thieme Verlag, Stuttgart, Germany.

Fourth Annual Report on Stress by Hans Selye, and Gunnar Heuser; Acta, Inc., Montreal, Canada.

Plastic Shins for Artificial Legs by Charles C. Asbell, and Thomas J. Canty; Amputation Center, USN Hospital, Oakland, Calif.

Textbook of the Rheumatic Diseases (Second Edition) edited by W.S.C. Copeman; The Williams & Wilkins Co., Baltimore.

Clinical Orthopaedics No. 4 edited by Anthony F. DePalma, et al; J. B. Lippincott Co., Philadelphia.

The Clinical Interview, Vol. 1—Diagnosis by F. Deutsch, and W. Murphy; International Universities Press, New York City.

Textbook of Healthful Living (Fifth Edition) by H. S. Diehl; McGraw-Hill Book Co., New York City.

Annual Review of Physiology (Volume 17) edited by V. E. Hall; Annual Reviews, Inc., Stanford, Calif.

Lobotomy A Clinical Study (Monograph 1) by A. Miller; Ontario Dept. of Health, Toronto, Canada.

Shoulder Lesions (Second Edition) by H. F. Moseley; Paul B. Hoeber, Inc., New York City.

Differential Diagnosis of Internal Diseases by Julius Bauer; Grune & Stratton, Inc., New York City.

Biological Specificity and Growth edited by Elmer G. Butler; Princeton University Press, Princeton, N.J.

Parkinsonism and Its Treatment edited by Lewis J. Doshay; J. B. Lippincott Co., Philadelphia.

1955 Medical Progress edited by Morris

Fishbein; The Blakiston Division, McGraw-Hill Book Co., New York City.

The Care of Your Skin by Herbert Lawrence; Little, Brown & Co., Boston.

Diagnosis and Localization of Brain Tumors by George E. Moore; Charles C. Thomas, Springfield, Ill.

Changing Attitudes Towards the Disabled edited by Norah Hill; Central Council for the Care of Cripples, London.

Newly Registered Therapists

February 11, 1955

Eltz, Ernest Victor, 5952 Whittier Blvd., Los Angeles

Eltz, Lillian Rose, 5952 Whittier Blvd., Los Angeles

Gibbs, Joan Louise, 9 N. Main St., Homer, N.Y.

Myers, Ray C., 1908 W. Commerce St., Dallas

Shultz, Edward Philip, 2258 Felspar, San Diego, Calif.

West, David Elgin, Box 34, Big Sandy, Mont.

February 21, 1955

Biscan, John Joseph, 1418 N. 8 St., St. Louis

Daily, Stanley Gerald, PO Box 352, Cloverdale, Calif.

Kinsella, Patricia Clare, 786 Kippley, Memphis, Tenn.

Ohta, Alvin Shinzo, 616 S. Hotel St., Honolulu, Hawaii.

March 3, 1955

House, Marian L., RR1, Anthony, Kans. Zeiner, Alois V., 248 Sinclair Ave., Glendale, Calif.

March 16, 1955

Harding, Leota Janzen, 1421 N. Central Ave., Glendale, Calif.

Johnson, Lawrence Russell, 467 Van Leuven St., Loma Linda, Calif.

King, Elmer Richard, 1733 E. 1st St., Los Angeles

Scheidler, Robert Homer, 1327 De Neve Lane, Los Angeles

Winslow, Gilbert Blair, 3429 Walnut Ave., Long Beach, Calif.

March 29, 1955

Hanna, Inga Haugaard, 15 Alberta Rd., Chestnut Hill, Mass.

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April 18, 1955

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PHYSICAL MEDICINE ABSTRACTS

Muscle Spasm as a Cause of Somatic Pain.
Deryck Taverner. *Ann. Rheumat. Dis.* 13(4): 331 (Dec.) 1954.

Pain which seems to affect the muscle predominantly is common. Many hypotheses regarding its cause have been developed, but few have been proved. The concept of "fibrosis" is now almost universally suspect. Other theories are still current and should undergo the same critical treatment as did "fibrosis."

The author investigated muscular spasm as a cause of pain, because it has been cited as the cause in a variety of disorders ranging from that of a ruptured intervertebral disk to psychoneurosis. Electromyographic testing was done because the clinical observation that some painful muscles are tender and firm on palpation may be misleading. The author concurs with others that painful muscular cramps are characterized by sustained electrical activity at frequencies of

300 per second or more. This is a frequency never achieved in the most intense voluntary contraction. In contrast with the high frequency activity of painful muscular cramps, there is relative or complete electrical silence of the skeletal muscles in most somatic pains. Muscles may become painful after activity, but the author's experiments excluded spasm, as defined, as the usual cause of muscle pain. The author associated muscular pain with muscular fatigue; however, he could not find associated electromyographic changes of significance with fatigue.

Rheumatoid Arthritis and Polyarteritis Nodosa. John Ball. *Ann. Rheumat. Dis.* 13(4):277 (Dec.) 1954.

A small minority of patients classified as suffering from rheumatoid arthritis, and a minority of patients classified as suffering from polyarteritis nodosa, show features of both syndromes. Five cases sharing these

syndromes are discussed and excellent photomicrographs are included.

The available evidence suggests that the distribution, frequency, and morphology of arterial lesions in rheumatoid arthritis are variable, ranging from a mild indeterminate arteritis to classical polyarteritis nodosa. Arteritis, more or less typical of polyarteritis nodosa, may occur in association with any of the collagen diseases. The implication is that in the presence of rheumatoid arthritis or other collagen disease, there is an increased susceptibility to arterial disease of the polyarteritis nodosa type. Slocumb and others have observed panangiitis and disseminated arteritis in patients with rheumatoid arthritis undergoing withdrawal from cortisone. It is clear that a similar sequence of panmesenchymal and panangiitic reactions may arise in the absence of ACTH or cortisone therapy. It is clinically important not because it occurs frequently, but because it may be fatal and may not be recognized readily when superimposed in a case of severe rheumatoid arthritis.

Thermal Control in Poliomyelitis. F. M. Allen, et al. Arch. Pediat. 71(11):354 (Nov.) 1954.

On the basis of current theories relative to destruction of nerve cells by direct viral invasion or anoxia resulting from interstitial edema, the authors reason that reduction of bodily temperature slows the growth of infectious organisms. This reduces edema, lowers the metabolic rate, and reduces the need for oxygen. They suggest that in acute poliomyelitis, protection of nerve centers can be achieved, during the first few days and until the usual systemic immunity is sufficient, by application of external cold. This procedure is said to control the febrile reaction of severe poliomyelitis and to reduce as much as possible the temperature in the spinal cord. These studies indicate that cold applied along the spine for twelve hours can reduce the temperature of the spinal fluid as much as ten degrees below bodily temperature.

Seventeen cases of acute poliomyelitis were treated by application of cold. The authors believe the fever in poliomyelitis to be "nervous" in type; i.e., not resisted by an abnormally elevated "thermostat." Therefore, the reduction in fever was easy, harmless, and seemingly beneficial. Producing a subnormal bodily temperature was avoided because it might reduce strength and resistance.

The series studied consisted of two fatal cases (in which cold therapy had been discontinued prior to the final febrile stage), five which had progression (perhaps these were modified), and ten with no progression. The series is too small to judge the question of retardation of the specific infection, but

theoretical considerations and the evident harmlessness of the method are believed to warrant further clinical trials.

Two benefits are claimed, theoretically and practically: Control of hyperpyrexia, which is always harmful and sometimes fatal; and relief from the respiratory labor created by the heightened metabolism of fever. The latter is a burden in any case where there are weakened respiratory muscles and is particularly serious in patients requiring respiratory aid.

Correlation of the Erythrocyte Sedimentation Rate and Gold Complications in Rheumatoid Arthritis. L. Kalliomaki. Ann. Rheum. Dis. 13(4):336 (Dec.) 1954.

It has been reported that complications during the use of gold in the treatment of rheumatoid arthritis are inversely proportional to the erythrocyte sedimentation rate. This is explained on the basis that in the active exudative stage of the disease, when the sedimentation rate is high, the globulin-bound gold penetrates the damaged capillaries into the diseased tissue. This prevents a high concentration of gold in the skin, bone marrow, and other normal tissues.

The author studied the relationship between the sedimentation rate and the complications resulting from gold therapy in 173 patients with rheumatoid arthritis. No correlation with the sedimentation rate was found in cases in which dermatitis or eosinophilic reactions developed. It is suggested that these reactions should be regarded chiefly as allergic. The incidence of leukopenia and proteinuria was higher in patients with a low sedimentation rate. It is suggested that leukopenia and proteinuria are more the result of toxic reactions to the gold.

Diagnostic Significance of Pulmonary Hypertrophic Osteoarthropathy. Alfred Vogl, et al. Am. J. Med. 28(1):51 (Jan.) 1955.

Clubbing of the fingers and toes was first described by Hippocrates. When acquired late in life, it is the outward manifestation of an often serious, visceral disorder. Many times it is seen as part of the classical triad; namely, clubbing of the fingers, periostitis and synovitis, associated with chronic disease of the chest and termed "pulmonary" osteoarthropathy.

Seven cases of pulmonary hypertrophic osteoarthropathy are presented and illustrate the following diagnostic features: Pain in the bones which is acute, deep-seated, burning in character, and aggravated by lowering of the extremities; stiffness of fingers; muscular weakness; broadened appearance of the distal thirds of the extremities due to edema; redness and warmth of skin of affected regions;

tenderness over affected bones and pain on motion of adjacent joints; progressive clubbing of tips of fingers and toes; rapid subsidence of pain and swelling after successful treatment of the underlying process; and x-ray evidence of symmetrical, lamellar, subperiosteal formation of bone along the diaphyses of the long bones.

The associated chest lesions ranged from chronic suppuration to intrathoracic neo-

plasms of all types. Metastases to the lung are rarely associated with arthropathy. However, early diagnosis of pulmonary carcinoma may be added because evidence of osteoarthropathy may precede symptoms of a pulmonary neoplasm by several months. There is a high incidence of osteoarthropathy in cases of malignant tumors of the lung—probably about ten per cent.

BOOK REVIEWS

The reviews here published have been prepared by competent authorities and do not necessarily represent the opinions of the American Congress of Physical Medicine and Rehabilitation and/or the American Society of Physical Medicine and Rehabilitation.

LEGAL MEDICINE. Edited by R. B. H. Gradwohl, M.D. Cloth. Price, \$20.00. Pp. 1093, with 222 illustrations. C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, 1954.

For anyone interested in legal medicine, this is an excellent text and reference. The sections on alcohol intoxication and wounds are particularly informative with better than average illustrations.

Complete bibliography, good format and a very fine index makes this work a most valuable addition to any medical library.

HUMAN PHYSIOLOGY. By Bernardo A. Houssay, M.D., et al. First edition. Cloth. Price, \$14.00. Pp. 1118, with illustrations. McGraw-Hill Book Company, Inc., 330 W. 42nd St., New York 36, 1951.

Human Physiology is written as a text book. It is particularly well balanced since the authors were in constant communication. Dr. Evans, an authority in the field, highly recommends the chapter on Endocrinology. The chapter on the Nervous System is of particular interest to the physiatrist though others on Circulation and on Respiration seem equally well planned and up to date.

The bibliography is good. Since the publication is authored by such outstanding scientists, the book should be in the library of physicians for reference purposes.

TREATMENT OF ACUTE POLIOMYELITIS. Edited by William A. Spencer, M.D. Second edition. Paper. Price, \$3.75. Pp. 134. Charles C. Thomas, Publisher, 301-327 E. Lawrence Ave., Springfield, Ill., 1954.

Some of the contributors to this work are nationally known in their fields; among these are Doctors Russell J. Blattner and Hebbel E. Hoff. The book, which has the general format of a ward manual or practical handbook, is divided into part 1, concerned with basic science aspects of acute poliomyelitis care with some concise treatment suggestions, and part 2, concerned with convalescent care. Persons in the field of physical medicine and rehabilitation will necessarily be much more concerned with the second part. There is a third part consisting of an appendix of useful tables and similar data.

The usual plan of one of the chapter headings consists of a statement followed by a series of comments in outline form. Each of these headings can be expanded into a paragraph and many are necessarily didactic and doctrinaire. The authors avoid controversy simply by stating their beliefs and letting it go at that. Such a presentation suffers necessarily from a point of view of scientific balance, but is quite proper to the purpose at hand. There may be minor disagreements by authorities concerning such matters as the dietary prevention of urinary tract stone formation, bowel care, and in some of the details of electrolyte balance. These minor disagree-

ments hardly detract from the value of the manual.

Of particular interest and value are sections on the weaning of the respiratory patient, the management of cardiovascular complications and the discussion of blood and respiratory gases. The physiatrist will find sections on stretching and muscle reeducation too brief and sketchy to be valuable. Instead they serve another purpose—that of orienting nurses and attendant staff toward the main features and functions of an integrated rehabilitation program.

The book is recommended as a ward manual of considerable use to the members of respiratory centers and rehabilitation facilities.

HUMAN PHYSIOLOGY. By *W. B. Youmans*, M.D. Cloth. Price, \$6.00. Pp. 481, with 226 illustrations. The Macmillan Company, 60 Fifth Ave., New York 11, 1954.

The author, as stated in the preface, has set out "to acquaint students with physiology in its broadest sense and applications"—a difficult goal indeed to achieve in a book of less than 500 pages.

Dr. Youmans has a didactic talent for skillfully presenting some of the more complicated physiological problems. This is a considerable help to medical students and others studying physiology on an undergraduate level.

This work more than meets the requirements for basic physiological knowledge of students of medicine and the other biological sciences and is recommended as a brief and concise foundation for further clinical and biological studies.

LIVING YOUR LATER YEARS. By *Kenneth Walker*. Cloth. Price, \$3.50. Pp. 196. Oxford University Press, 114 Fifth Ave., New York 11, 1954.

The author, a distinguished British surgeon and a septuagenarian, is well qualified to discuss his subject. He mentions in the preface that the general public shows little interest in growing old and that most people prefer to expel thoughts of old age from their mind because they are "an unpleasant reminder of the transience of human life." He then endeavors to show that there is no phase of life for which preparation is more necessary or more rewarding. He succeeds very well in achieving his aim.

Walker wisely points out that if a man never develops any interests outside his business or profession, surely he has only himself to blame when, after his retirement, he can find nothing to do and, as the consequence of this, loses all zest for living. He mentions cogently that "it is just as important to take forethought and to make pro-

vision for old age as it is to prepare a child for adult life." This is a scholarly book by a well-read physician who is familiar with the classics and therefore it is extremely interesting.

He makes the encouraging statement that many elderly people have declared, in all sincerity, that old age is the most interesting period of their lives. He stresses wisely the importance of remaining active and creative. The chapter on the philosophy of old age is delightful reading, and in the final chapter, certain important truths are stressed. The recent trend toward building separate living quarters for elderly people is decried. It is pointed out that "all old people enjoy the proximity and the companionship of the young" and the author states that "in the United States as in Great Britain, old people have a strong aversion to all forms of institutional life and much prefer to live in private homes." Walker concludes that there is great unanimity of opinion in different countries concerning the management of the problems of aging.

In summary, the needs of the aging can be classified (1) to maintain physical health; (2) to have recreational activities; (3) to retain a feeling of recognition or of belonging; (4) to have suitable employment in occupations that are part of the productive life of the community; (5) to have counselling centers; (6) to have living arrangements which maintain self-respect and privacy; (7) to have financial security and, (8) to have legislation that will ameliorate conditions adversely affecting the later years of life.

This book is highly recommended as one which can be read with pleasure and profit by anyone approaching old age. It can be recommended to intelligent patients by physicians who are striving to help patients having geriatric problems.

AN OUTLINE OF NEUROLOGY. By *Ian A. Brown*, M.D. Paper. Price, \$2.00. Pp. 72, with illustrations. Wm. C. Brown Company, Dubuque, Iowa, 1954.

Dr. Brown, Assistant Professor of Neurology at the University of Minnesota, has developed this outline of neurology not only for the benefit of the physicians but also for nurses, physical therapists and occupational therapists. It briefly defines the anatomy of the nervous system as a whole and then proceeds to diagnose and explain the etiology of the pathology affecting the various parts of the nervous system. Treatment is then outlined.

After describing the peripheral nerve, spinal cord and brain, with their disorders, he devotes a section to disorders of muscle function. Here myasthenia gravis, and pro-

gressive muscular dystrophy are defined in outline with methods of treatment mentioned. Sections on psychotic reaction and diagnostic and therapeutic procedures are included. No bibliography is listed, but this outline could be very valuable in connection with lectures or as a basis for reading.

DIE WIRBELSAULENVERLETZUNGEN UND IHRE AUSHEILUNG (Injuries to the Vertebral Column and How They Are Repaired). By Prof. Dr. Med. Alfons Lob. Cloth. Price, \$18.55. Pp. 340, with 149 illustrations and 16 tables. Georg Thieme Verlag, (14a) Stuttgart, Germany, 1954.

This second edition is enlarged and completely recast. On a basis of pathological anatomy the author proceeds to details of roentgenographic diagnosis and principles of treatment, and the concluding section (pages 153 to 257) deals with the problems of prognosis, appraisal, insurance, and compensation. In addition to well-organized reviews of previous publications, the author contributes a wealth of original material in the form of roentgenograms from patients and photographs from necropsy specimens. The illustrations and diagrams are of excellent quality, and the text is happily free from examples of the long, complex sentence that makes some German books unreadable.

Of special practical interest to everyone is the section dealing with the treatment of injuries that involve the spinal cord (p. 104 ff.). The book is highly recommended to pathologists and surgeons, and without it no library of orthopedics will be complete.

MODERN OCCUPATIONAL MEDICINE. Edited by A. J. Fleming, M.D.; C. A. D'Alonzo, M.D., and J. A. Zapp, Ph.D. Cloth. Price, \$10.00. Pp. 414, with 44 illustrations and 32 tables. Lippincott, Philadelphia 6, 1954.

This fairly brief text, which has been compiled by personnel of the E. I. du Pont de Nemours & Company, covers the entire field of occupational medicine from the examination of prospective employees to the physician's role in industrial safety. The material is easily read and understandable and gives one a quick review of the manifold problems of occupational medicine.

Only a small amount of material in this book is of value to the practicing physiatrist in the management of specific patients. However, for the physiatrist who works closely with the industrial physician in assisting with the management of patients who have been injured in industry, the book provides a clear description of the many facets of occupational medicine. From this standpoint, the physiatrist can understand the problems of the industrial physician and as a result will

be able to cooperate with him for the benefit of the individual patient.

In the one chapter describing personnel requirements, physical location and layout of an industrial medicine facility, it seems that the authors are quite ambitious concerning the requirements of medicine in industry. The requirement of one physician per thousand employees purely for the purpose of preventive medicine and various responsibilities of an industrial organization seems greater than actually necessary. From a practical standpoint, the medical profession could not provide enough physicians to give this type of service, at least for the immediate future.

Generally speaking, this is a valuable volume for any physician who comes in contact with occupational medicine either as a consultant or as an industrial physician.

HEALTHIER LIVING. By Justus J. Schifferes, Ph.D. Cloth. Price, \$6.75. Pp. 928, with illustrations. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, 1955.

Healthier Living is a compendium of medical knowledge for the layman and in particular for the student of health. Divided into five parts; introduction and orientation, education for family living, mental health, personal health, and community health, each subject is briefly discussed. Human development and reproduction are treated simply and intelligently as are the degenerative diseases and public health problems in general. In somewhat greater detail, there are chapters concerned with physiology of exercise, body mechanics, and personal hygiene. Of special interest to the student, for whom such a text would be adaptable, is the well-selected and annotated bibliography following each chapter. The author has a pleasant and colorful style. The book can be recommended in health education.

LOOK BETTER, FEEL BETTER. By Bess M. Mensendieck, M.D. Cloth. Price, \$3.50. Pp. 276. Harper & Brothers, 49 E. 33rd St., New York 16, 1954.

This book is addressed to the general public and undertakes to awaken the individual to a greater awareness of his muscles and joints. The purpose, referred to as "body sculpturing," is to improve habits of sitting, standing, walking, and breathing.

The author attempts to do this practically without the help of anatomical diagrams and without calling the muscles and bones by their exact names. Thus the reader is left in the dark as to the location and action of the intercostal muscles (p. 142), and it is necessary to use such phrases as "sitting-bone" and "the muscles along the inner margin of the thigh." The author also shuns the word "exercise" in favor of "Movement

Scheme." These devices sometimes make the author sound a bit illiterate and make one wonder whether the intelligence of the American public can really be so low. It used to be considered quite possible to teach words of two syllables like "sacrum" or even three syllables like "radius" to children in seventh grade. At present it is necessary to sneak anatomy and physiology into high school courses under such titles as "health education." Perhaps it is well to recognize the present antiscientific trend (while hoping that it may soon be reversed) and to make books like this available to people who will not learn in school.

Part I "The Key to Shaping Your Body" contains three chapters on the general plan of the Mensendieck method, on general aspects of muscular action, and on sitting and standing posture. Part II "The Movement Schemes" consists of nineteen chapters describing exercises for various purposes such as flattening the abdomen, "sculpturing" the chest, and so on. It must be admitted that the conscientious performance of these exercises would be beneficial to any normal person. The author's attitude is not that of the crackpot or the cultist but that of one who is anxious to be understood. The illustrations are attractive, and the book contains much of value.

ADVANCES IN CANCER RESEARCH.
Edited by Jesse P. Greenstein, and Alexander Haddow. Volume II. Cloth. Price, \$11.00. Pp. 530. Academic Press Inc., Publishers, 125 East 23rd St., New York, 1954.

Volume II of this work is divided into ten chapters.

A working hypothesis of tumor pathogenesis is discussed as a two stage mechanism. The first stage deals with the initiating action that results in dormant tumor cells. These are then converted to growing tumors in the second stage or that of promoting action. Also discussed is the reversible stage of responsiveness followed by an irreversible stage of progression.

The earliest experimentally induced tumors were produced by ionizing radiations. Now that so many new isotopes have been added to the doctor's armamentarium, the total number of carcinogenic agents has been increased. The "Survival and Preservation of Tumors in the Frozen State" is discussed by James Craigie, Imperial Cancer Research Fund, London, England. Much of the recent literature on tumor growth deals with the systemic and nutritional consequences of such growth. This subject is reviewed by Leonard D. Fenninger and G. Burroughs Mider of the National Cancer Institute of Bethesda, Md.

A careful review is given of the effect of HN2 upon skin and appendages, plasma, hematopoietic system, respiratory tract, gas-

trointestinal tract, liver and pancreas, kidney, genital tract, central nervous system, endocrine glands, and general metabolism. Also discussed are methods for counteracting the toxic effects of this interesting group of drugs.

Also included is a chapter on "Genetic Studies in Experimental Cancer" including mammary cancer, pulmonary tumors, leukemia, and other neoplasms. "The Role of Viruses in the Production of Cancer" includes a discussion of virus-induced tumors of birds, tumors of cold-blooded animals, and tumors of mammals.

Information covering synthetic chemicals, such as nitrogen mustards, ethylenimines and epoxides; antimetabolites, steroids and carbamates; materials of natural origin from animals, from higher plants, and from microorganisms is presented. Also discussed briefly is the use of radioactive isotopes in experimental cancer thermotherapy.

This volume fails to mention anything of the present discussion of cigarettes as a possible cause for cancer. This reviewer would also like to see a discussion of emotional factors in cancer research. Each chapter is followed by a complete listing of references. An author and subject index complete the volume.

TIME DISTORTION IN HYPNOSIS.
By Linn F. Cooper, M.D., and Milton H. Erickson, M.D. Cloth. Price, \$4.00. Pp. 191, with illustrations. The Williams & Wilkins Co., Mt. Royal and Guilford Aves., Baltimore 2, 1954.

Time distortion in the hallucinatory experiences of hypnotized subjects has long been observed, but this work makes a pioneer attempt to understand the phenomenon and to utilize it in experimentation. It is an initial step into what may prove to be a fertile field of knowledge regarding hypnosis, hypnotherapy, thinking, learning, and time itself. Part I of the monograph by Doctor Cooper, describes experimental studies; Part II by Doctor Erickson, discusses clinical and therapeutic applications. The experiments are written with rather monotonous detail, but the implications of the studies make them worth wading through the irrelevancies and repetitions.

As it should be in a series of pilot studies, this work raises more questions than it answers, and areas of further research are opened. Especially promising are the implications that creative thought and non-motor learning can be facilitated under conditions of time distortion. The word to describe the case material in Part II is "intriguing." Dramatic results indicate that utilization of time distortion in hypnosis, if skillfully handled, may prove to be a very effective and time-conserving method in psychotherapy.

MEDICAL USES OF CORTISONE INCLUDING HYDROCORTISONE AND CORTICOTROPIN. Edited by *Francis D. W. Lukens, M.D.* Cloth. Price, \$7.50. Pp. 534, with 52 illustrations. Blakiston Division, McGraw-Hill Book Company, Inc., 330 W. 42nd St., New York 36, 1954.

Represented in this monograph are the combined efforts of twenty-nine authorities covering recent, practical and sound knowledge concerning the use of cortisone, hydrocortisone, and corticotropin in the various medical specialties. This has been admirably done in the fifteen chapters comprising the text. Subjects covered include physiology of the adrenal gland, pharmacologic aspects of adrenocortical hormones in man, rheumatoid arthritis and other rheumatic and articular diseases, rheumatic fever, other collagen diseases, asthma and rhinitis, allergic reactions to therapeutic agents, diseases affecting the skin, eye diseases, gastro-intestinal diseases, diseases of the kidneys, etc. The material is well written and makes for easy, worthwhile, and most valuable reading. The illustrations are excellent.

It can be highly recommended for use as a reference text inasmuch as the material is so complete, yet readily accessible and understandable.

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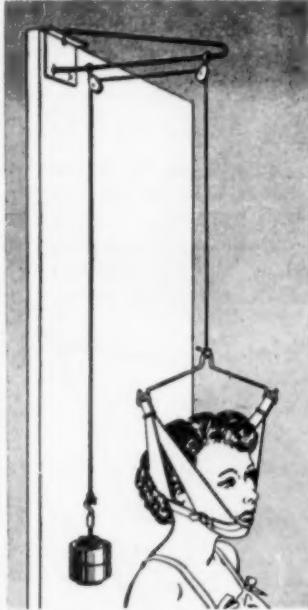
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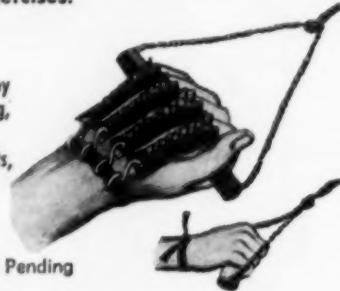
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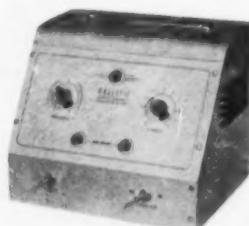
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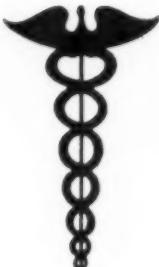
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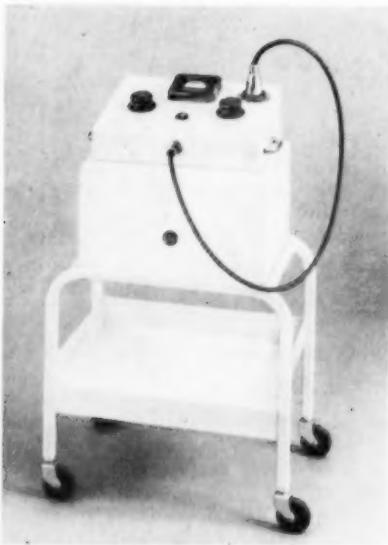
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1. Any subject of interest or pertaining to the field of physical medicine and rehabilitation may be submitted.
2. Manuscripts **must be** in the office of the American Congress of Physical Medicine and Rehabilitation, 30 N. Michigan Ave., Chicago 2, not later than June 1, 1955.
3. Contributions will be accepted from medical students, internes, residents, graduate students in the pre-clinical sciences, and graduate students in physical medicine and rehabilitation.
4. The essay must not have been published previously.
5. The American Congress of Physical Medicine and Rehabilitation shall have the exclusive right to publish the winning essay in its official journal, the **ARCHIVES OF PHYSICAL MEDICINE AND REHABILITATION**.
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